**################################################################**

**## ##**

**## CUTE LITTLE R FUNCTIONS v6.0.0 ##**

**## ##**

**## Gael A. Millot ##**

**## ##**

**## Compatible with R v3.5.3 ##**

**## ##**

**################################################################**

**# https://usethis.r-lib.org/ and usethat also**

**# BEWARE: do not forget to save the modifications in the .R file (through RSTUDIO for indentation)**

**# add print warning argument using warning(warnings)**

**# update graphic examples with good comment, as in barplot**

**# Templates: https://prettydoc.statr.me/themes.html**

**# https://pkgdown.r-lib.org/**

**# https://rdrr.io/github/gastonstat/cointoss/**

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**################################ FUNCTIONS ################################**

################ Object analysis

######## fun\_check() #### check class, type, length, etc., of objects

**# Check OK: clear to go Apollo**

**fun\_check <- function(data, data.name = NULL, class = NULL, typeof = NULL, mode = NULL, length = NULL, prop = NULL, double.as.integer.allowed = FALSE, options = NULL, all.options.in.data = FALSE, na.contain = FALSE, neg.values = TRUE, print = TRUE, fun.name = NULL){**

*# AIM*

*# check the class, type, mode and length of the data argument*

*# mainly used to check the arguments of other functions*

*# check also other kind of data parameters, is it a proportion? Is it type double but numbers without decimal part?*

*# if options = NULL, then at least class, type, mode or length must be non null*

*# if options is non null, then class, type and mode must be NULL, and length can be NULL or specified*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# none*

*# ARGUMENTS*

*# data: object to test*

*# data.name: name of the object to test. If NULL, use the name of the object assigned to the data argument*

*# class: one of the class() result or "vector"*

*# typeof: one of the typeof() result*

*# mode: one of the mode() result (for non vector object)*

*# length: length of the object*

*# prop: logical, are the numeric values between 0 and 1 (proportion)?*

*# double.as.integer.allowed: logical. If TRUE, no error is reported if argument is set to typeof = "integer" or class = "integer", while the reality is typeof = "double" or class = "numeric" but the numbers have a zero as modulo (remainder of a division). This means that i<-1 , which is typeof(i) -> "double" is considered as integer with double.as.integer.allowed = TRUE*

*# options: a vector of possible values for data*

*# all.options.in.data: If TRUE, all of the options must be present at least once in data, and nothing else. If FALSE, some of the options must be present in data, and nothing else*

*# na.contain: can data contains NA?*

*# neg.values: are negative numeric values authorized? BEWARE: only considered if set to FALSE, to check for non negative values when class is set to "numeric", "matrix", "array", "data.frame", "table", or typeof is set to "double", "integer", or mode is set to "numeric"*

*# print: print the error message if $problem is TRUE?*

*# fun.name: name of the function when fun\_check() is used to check its argument. If non NULL, name will be added into the error message returned by fun\_check()*

*# RETURN*

*# a list containing:*

*# $problem: logical. Is there any problem detected ?*

*# $text: the problem detected*

*# $param.name: name of the checked parameter*

*# EXAMPLES*

*# test <- 1:3 ; fun\_check(data = test, data.name = NULL, print = TRUE, options = NULL, all.options.in.data = FALSE, class = NULL, typeof = NULL, mode = NULL, prop = TRUE, double.as.integer.allowed = FALSE, length = NULL)*

*# test <- 1:3 ; fun\_check(data = test, print = TRUE, class = "numeric", typeof = NULL, double.as.integer.allowed = FALSE)*

*# test <- 1:3 ; fun\_check(data = test, print = TRUE, class = "vector", mode = "numeric")*

*# test <- matrix(1:3) ; fun\_check(data = test, print = TRUE, class = "vector", mode = "numeric")*

*# DEBUGGING*

*# data = expression(TEST) ; data.name = NULL ; class = "vector" ; typeof = NULL ; mode = NULL ; length = 1 ; prop = NULL ; double.as.integer.allowed = FALSE ; options = NULL ; all.options.in.data = FALSE ; na.contain = FALSE ; neg.values = TRUE ; print = TRUE ; fun.name = NULL*

*# function name: no used in this function for the error message, to avoid env colliding*

*# argument checking*

**if( ! is.null(data.name)){**

**if( ! (length(data.name) == 1 & class(data.name) == "character")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): data.name ARGUMENT MUST BE A SINGLE CHARACTER ELEMENT AND NOT ", paste(data.name, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if(is.null(options) & is.null(class) & is.null(typeof) & is.null(mode) & is.null(prop) & is.null(length)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): AT LEAST ONE OF THE options, class, typeof, mode, prop, OR length ARGUMENT MUST BE SPECIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(options) & ( ! is.null(class) | ! is.null(typeof) | ! is.null(mode) | ! is.null(prop))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE class, typeof, mode AND prop ARGUMENTS MUST BE NULL IF THE option ARGUMENT IS SPECIFIED\nTHE option ARGUMENT MUST BE NULL IF THE class AND/OR typeof AND/OR mode AND/OR prop ARGUMENT IS SPECIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (all(class(neg.values) == "logical") & length(neg.values) == 1 & any(is.na(neg.values)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE neg.values ARGUMENT MUST BE TRUE OR FALSE ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(neg.values == FALSE & is.null(class) & is.null(typeof) & is.null(mode)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE neg.values ARGUMENT CANNOT BE SWITCHED TO FALSE IF class, typeof AND mode ARGUMENTS ARE NULL\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(class)){**

**if( ! all(class %in% c("vector", "logical", "integer", "numeric", "complex", "character", "matrix", "array", "data.frame", "list", "factor", "table", "expression", "name", "symbol", "function", "uneval") & any(is.na(class)) != TRUE)){** *# not length == 1 here because ordered factors are class "factor" "ordered" (length == 2)*

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): class ARGUMENT MUST BE ONE OF THESE VALUE:\n\"vector\", \"logical\", \"integer\", \"numeric\", \"complex\", \"character\", \"matrix\", \"array\", \"data.frame\", \"list\", \"factor\", \"table\", \"expression\", \"name\", \"symbol\", \"function\" \n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(neg.values == FALSE & ! any(class %in% c("vector", "numeric", "integer", "matrix", "array", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): class ARGUMENT CANNOT BE OTHER THAN \"vector\", \"numeric\", \"integer\", \"matrix\", \"array\", \"data.frame\", \"table\" IF neg.values ARGUMENT IS SWITCHED TO FALSE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(typeof)){**

**if( ! (all(typeof %in% c("logical", "integer", "double", "complex", "character", "list", "expression", "name", "symbol", "closure", "special", "builtin")) & length(typeof) == 1 & any(is.na(typeof)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): typeof ARGUMENT MUST BE ONE OF THESE VALUE:\n\"logical\", \"integer\", \"double\", \"complex\", \"character\", \"list\", \"expression\", \"name\", \"symbol\", \"closure\", \"special\", \"builtin\" \n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(neg.values == FALSE & ! typeof %in% c("double", "integer")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): typeof ARGUMENT CANNOT BE OTHER THAN \"double\" OR \"integer\" IF neg.values ARGUMENT IS SWITCHED TO FALSE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(mode)){**

**if( ! (all(mode %in% c("logical", "numeric", "complex", "character", "list", "expression", "name", "symbol", "function")) & length(mode) == 1 & any(is.na(mode)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): mode ARGUMENT MUST BE ONE OF THESE VALUE:\n\"logical\", \"numeric\", \"complex\", \"character\", \"list\", \"expression\", \"name\", \"symbol\", \"function\"\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(neg.values == FALSE & mode != "numeric"){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): mode ARGUMENT CANNOT BE OTHER THAN \"numeric\" IF neg.values ARGUMENT IS SWITCHED TO FALSE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(length)){**

**if( ! (is.numeric(length) & length(length) == 1 & ! grepl(length, pattern = "\\.") & any(is.na(length)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): length ARGUMENT MUST BE A SINGLE INTEGER VALUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(prop)){**

**if( ! (is.logical(prop) | length(prop) == 1 & any(is.na(prop)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): prop ARGUMENT MUST BE TRUE OR FALSE ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(prop == TRUE){**

**if( ! is.null(class)){**

**if( ! any(class %in% c("vector", "numeric", "integer", "matrix", "array", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): class ARGUMENT CANNOT BE OTHER THAN \"vector\", \"numeric\", \"integer\", \"matrix\", \"array\", \"data.frame\", \"table\" IF prop ARGUMENT IS TRUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(mode)){**

**if(mode != "numeric"){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): mode ARGUMENT CANNOT BE OTHER THAN \"numeric\" IF prop ARGUMENT IS TRUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(typeof)){**

**if(typeof != "double"){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): typeof ARGUMENT CANNOT BE OTHER THAN \"double\" IF prop ARGUMENT IS TRUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**}**

**if( ! (all(class(double.as.integer.allowed) == "logical") & length(double.as.integer.allowed) == 1 & any(is.na(double.as.integer.allowed)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE double.as.integer.allowed ARGUMENT MUST BE TRUE OR FALSE ONLY: ", paste(double.as.integer.allowed, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (is.logical(all.options.in.data) & length(all.options.in.data) == 1 & any(is.na(all.options.in.data)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): all.options.in.data ARGUMENT MUST BE A SINGLE LOGICAL VALUE (TRUE OR FALSE ONLY): ", paste(all.options.in.data, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (all(class(na.contain) == "logical") & length(na.contain) == 1 & any(is.na(na.contain)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE na.contain ARGUMENT MUST BE TRUE OR FALSE ONLY: ", paste(na.contain, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (all(class(print) == "logical") & length(print) == 1 & any(is.na(print)) != TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE print ARGUMENT MUST BE TRUE OR FALSE ONLY: ", paste(print, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(fun.name)){**

**if( ! (class(fun.name) == "character" & length(fun.name) == 1)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN fun\_check(): THE fun.name ARGUMENT MUST BE A CHARACTER VECTOR OF LENGTH 1: ", paste(fun.name, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) # activate this line and use the function to check arguments status*

*# end argument checking*

*# main code*

**if(is.null(data.name)){**

**data.name <- deparse(substitute(data))**

**}**

**problem <- FALSE**

**text <- paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER")**

**if( ! is.null(options)){**

**text <- ""**

**if( ! all(data %in% options)){**

**problem <- TRUE**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE ", data.name, " PARAMETER MUST BE SOME OF THESE OPTIONS: ", paste(options, collapse = " "), "\nTHE PROBLEMATIC ELEMENTS OF ", data.name, " ARE: ", paste(unique(data[ ! (data %in% options)]), collapse = " "))**

**}**

**if(all.options.in.data == TRUE){**

**if( ! all(options %in% data)){**

**problem <- TRUE**

**if(text == ""){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE ", data.name, " PARAMETER MUST BE SOME OF THESE OPTIONS: ", paste(options, collapse = " "), "\nTHE PROBLEMATIC ELEMENTS OF ", data.name, " ARE: ", unique(data[ ! (data %in% options)]))**

**}else{**

**text <- paste0(text, "\n", ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE ", data.name, " PARAMETER MUST BE SOME OF THESE OPTIONS: ", paste(options, collapse = " "), "\nTHE PROBLEMATIC ELEMENTS OF ", data.name, " ARE: ", unique(data[ ! (data %in% options)]))**

**}**

**}**

**}**

**if( ! is.null(length)){**

**if(length(data) != length){**

**problem <- TRUE**

**if(text == ""){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE LENGTH OF ", data.name, " MUST BE ", length, " AND NOT ", length(data))**

**}else{**

**text <- paste0(text, "\n", ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE LENGTH OF ", data.name, " MUST BE ", length, " AND NOT ", length(data))**

**}**

**}**

**}**

**if(text == ""){**

**text <- paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER")**

**}**

**}**

**arg.names <- c("class", "typeof", "mode", "length")**

**if(is.null(options)){**

**for(i2 in 1:length(arg.names)){**

**if( ! is.null(get(arg.names[i2]))){**

*# script to execute*

**tempo.script <- '**

**problem <- TRUE ;**

**if(identical(text, paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER"))){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": THE ", data.name, " PARAMETER MUST BE ") ;**

**}else{**

**text <- paste0(text, " AND ");**

**}**

**text <- paste0(text, toupper(arg.names[i2]), " ", get(arg.names[i2]))**

**'**

*# end script to execute*

**if(typeof(data) == "double" & double.as.integer.allowed == TRUE & ((arg.names[i2] == "class" & get(arg.names[i2]) == "integer") | (arg.names[i2] == "typeof" & get(arg.names[i2]) == "integer"))){**

**if(! all(data%%1 == 0)){** *# to check integers (use %%, meaning the remaining of a division): see the precedent line*

**eval(parse(text = tempo.script))** *# execute tempo.script*

**}**

**}else if(get(arg.names[i2]) != "vector" & eval(parse(text = paste0(arg.names[i2], "(data)"))) != get(arg.names[i2])){**

**eval(parse(text = tempo.script))** *# execute tempo.script*

**}else if(arg.names[i2] == "class" & get(arg.names[i2]) == "vector" & ! (class(data) == "numeric" | class(data) == "integer" | class(data) == "character" | class(data) == "logical")){**

**eval(parse(text = tempo.script))** *# execute tempo.script*

**}**

**}**

**}**

**}**

**if( ! is.null(prop)){**

**if(prop == TRUE){**

**if(any(data < 0 | data > 1, na.rm = TRUE)){**

**problem <- TRUE**

**if(identical(text, paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER"))){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": ")**

**}else{**

**text <- paste0(text, " AND ")**

**}**

**text <- paste0(text, "THE ", data.name, " PARAMETER MUST BE DECIMAL VALUES BETWEEN 0 AND 1")**

**}**

**}**

**}**

**if(all(class(data) %in% "expression")){**

**data <- as.character(data)** *# to evaluate the presence of NA*

**}**

**if(na.contain == FALSE & any(is.na(data)) == TRUE){**

**problem <- TRUE**

**if(identical(text, paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER"))){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": ")**

**}else{**

**text <- paste0(text, " AND ")**

**}**

**text <- paste0(text, "THE ", data.name, " PARAMETER CONTAINS NA WHILE NOT AUTHORIZED (na.contain ARGUMENT SET TO FALSE)")**

**}**

**if(neg.values == FALSE){**

**if(any(data < 0, na.rm = TRUE)){**

**problem <- TRUE**

**if(identical(text, paste0(ifelse(is.null(fun.name), "", paste0("IN ", fun.name, ": ")), "NO PROBLEM DETECTED FOR THE ", data.name, " PARAMETER"))){**

**text <- paste0(ifelse(is.null(fun.name), "ERROR", paste0("ERROR IN ", fun.name)), ": ")**

**}else{**

**text <- paste0(text, " AND ")**

**}**

**text <- paste0(text, "THE ", data.name, " PARAMETER MUST BE NON NEGATIVE NUMERIC VALUES")**

**}**

**}**

**if(print == TRUE & problem == TRUE){**

**cat(paste0("\n\n================\n\n", text, "\n\n================\n\n"))**

**}**

**output <- list(problem = problem, text = text, param.name = data.name)**

**return(output)**

**}**

######## fun\_info() #### recover object information

**# Check OK: clear to go Apollo**

**fun\_info <- function(data){**

*# AIM*

*# provide a full description of an object*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# none*

*# ARGUMENTS*

*# data: object to test*

*# RETURN*

*# a list containing the info*

*# please, use names(fun\_info()) and remove what can be too big for easy analysis*

*# EXAMPLES*

*# fun\_info(data = 1:3)*

*# fun\_info(data.frame(a = 1:2, b = ordered(factor(c("A", "B")))))*

*# fun\_info(list(a = 1:3, b = ordered(factor(c("A", "B")))))*

*# DEBUGGING*

*# data = NULL # for function debugging*

*# data = 1:3 # for function debugging*

*# data = matrix(1:3) # for function debugging*

*# data = data.frame(a = 1:2, b = c("A", "B")) # for function debugging*

*# data = factor(c("b", "a")) # for function debugging*

*# data = ordered(factor(c("b", "a"))) # for function debugging*

*# data = list(a = 1:3, b = factor(c("A", "B"))) # for function debugging*

*# data = list(a = 1:3, b = ordered(factor(c("A", "B")))) # for function debugging*

*# function name: no need because no check and no message*

*# argument checking*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) # activate this line and use the function to check arguments status*

*# end argument checking*

*# main code*

**data.name <- deparse(substitute(data))**

**output <- list("NAME" = data.name)**

**tempo <- list("CLASS" = class(data))**

**output <- c(output, tempo)**

**tempo <- list("TYPE" = typeof(data))**

**output <- c(output, tempo)**

**tempo <- list("HEAD" = head(data))**

**output <- c(output, tempo)**

**if( ! is.null(data)){**

**tempo <- list("TAIL" = tail(data))**

**output <- c(output, tempo)**

**if( ! is.null(dim(data))){**

**tempo <- list("DIMENSION" = dim(data))**

**names(tempo[[1]]) <- c("NROW", "NCOL")**

**output <- c(output, tempo)**

**}**

**tempo <- list("SUMMARY" = summary(data))**

**output <- c(output, tempo)**

**}**

**if(all(class(data) == "data.frame" | class(data) == "matrix")){**

**tempo <- list("ROW\_NAMES" = dimnames(data)[[1]])**

**output <- c(output, tempo)**

**tempo <- list("COLUM\_NAMES" = dimnames(data)[[2]])**

**output <- c(output, tempo)**

**}**

**if(all(class(data) == "data.frame")){**

**tempo <- list("STRUCTURE" = ls.str(data))**

**output <- c(output, tempo)**

**tempo <- list("COLUMN\_TYPE" = sapply(data, FUN = "typeof"))**

**if(any(sapply(data, FUN = "class") %in% "factor")){** *# if an ordered factor is present, then sapply(data, FUN = "class") return a list but works with any(sapply(data, FUN = "class") %in% "factor")*

**tempo.class <- sapply(data, FUN = "class")**

**if(any(unlist(tempo.class) %in% "ordered")){**

**tempo2 <- sapply(tempo.class, paste, collapse = " ")** *# paste the "ordered" factor" in "ordered factor"*

**}else{**

**tempo2 <- unlist(tempo.class)**

**}**

**tempo[["COLUMN\_TYPE"]][grepl(x = tempo2, pattern = "factor")] <- tempo2[grepl(x = tempo2, pattern = "factor")]**

**}**

**output <- c(output, tempo)**

**}**

**if(all(class(data) == "list")){**

**tempo <- list("COMPARTMENT\_NAMES" = names(data))**

**output <- c(output, tempo)**

**tempo <- list("COMPARTMENT\_TYPE" = sapply(data, FUN = "typeof"))**

**if(any(unlist(sapply(data, FUN = "class")) %in% "factor")){** *# if an ordered factor is present, then sapply(data, FUN = "class") return a list but works with any(sapply(data, FUN = "class") %in% "factor")*

**tempo.class <- sapply(data, FUN = "class")**

**if(any(unlist(tempo.class) %in% "ordered")){**

**tempo2 <- sapply(tempo.class, paste, collapse = " ")** *# paste the "ordered" factor" in "ordered factor"*

**}else{**

**tempo2 <- unlist(tempo.class)**

**}**

**tempo[["COMPARTMENT\_TYPE"]][grepl(x = tempo2, pattern = "factor")] <- tempo2[grepl(x = tempo2, pattern = "factor")]**

**}**

**output <- c(output, tempo)**

**}**

**return(output)**

**}**

######## fun\_1d\_comp() #### comparison of two 1D datasets (vectors, factors, 1D tables)

**# Check OK: clear to go Apollo**

**fun\_1d\_comp <- function(data1, data2){**

*# AIM*

*# compare two 1D datasets (vector of factor or 1D table) of the same class or not. Check and report in a list if the 2 datasets have:*

*# same class*

*# common elements*

*# common element names (except factors)*

*# common levels (factors only)*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# none*

*# ARGUMENTS*

*# data1: vector or factor or 1D table*

*# data2: vector or factor or 1D table*

*# RETURN*

*# a list containing:*

*# $same.class: logical. Are class identical?*

*# $class: class of the 2 datasets (NULL otherwise)*

*# $same.length: logical. Are number of elements identical?*

*# $length: number of elements in the 2 datasets (NULL otherwise)*

*# $same.levels: logical. Are levels identical? (NULL if data1 and data2 are not factors)*

*# $levels: levels of the 2 datasets if identical (NULL otherwise or NULL if data1 and data2 are not factors)*

*# $any.id.levels: logical. Is there any identical levels? (NULL if data1 and data2 are not factors)*

*# $same.levels.pos1: position, in data1, of the levels identical in data2 (NULL if data1 and data2 are not factors)*

*# $same.levels.pos2: position, in data2, of the levels identical in data1 (NULL if data1 and data2 are not factors)*

*# $common.levels: common levels between data1 and data2 (can be a subset of $levels or not). NULL if no common levels or if data1 and data2 are not factors*

*# $same.name: logical. Are element names identical ?*

*# $name: name of elements of the 2 datasets if identical (NULL otherwise)*

*# $any.id.name: logical. Is there any element names identical ?*

*# $same.name.pos1: position, in data1, of the element names identical in data2*

*# $same.name.pos2: position, in data2, of the elements names identical in data1*

*# $common.names: common element names between data1 and data2 (can be a subset of $name or not). NULL if no common element names*

*# $any.id.element: logical. is there any identical elements ?*

*# $same.element.pos1: position, in data1, of the elements identical in data2*

*# $same.element.pos2: position, in data2, of the elements identical in data1*

*# $common.elements: common elements between data1 and data2. NULL if no common elements*

*# $identical.object: logical. Are objects identical (kind of object, element names and content)?*

*# $identical.content: logical. Are content objects identical (identical elements excluding kind of object and element names)?*

*# EXAMPLES*

*# obs1 = 1:5 ; obs2 = 1:5 ; names(obs1) <- LETTERS[1:5] ; names(obs2) <- LETTERS[1:5] ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = 1:5 ; obs2 = 1:5 ; names(obs1) <- LETTERS[1:5] ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = 1:5 ; obs2 = 3:6 ; names(obs1) <- LETTERS[1:5] ; names(obs2) <- LETTERS[1:4] ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = factor(LETTERS[1:5]) ; obs2 = factor(LETTERS[1:5]) ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = factor(LETTERS[1:5]) ; obs2 = factor(LETTERS[10:11]) ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = factor(LETTERS[1:5]) ; obs2 = factor(LETTERS[4:7]) ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = 1:5 ; obs2 = factor(LETTERS[1:5]) ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = 1:5 ; obs2 = 1.1:6.1 ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = as.table(1:5); obs2 = as.table(1:5) ; fun\_1d\_comp(obs1, obs2)*

*# obs1 = as.table(1:5); obs2 = 1:5 ; fun\_1d\_comp(obs1, obs2)*

*# DEBUGGING*

*# data1 = 1:5 ; data2 = 1:5 ; names(data1) <- LETTERS[1:5] ; names(data2) <- LETTERS[1:5] # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# argument checking*

**if( ! any(class(data1) %in% c("logical", "integer", "numeric", "character", "factor", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A NON NULL VECTOR, FACTOR OR 1D TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(all(class(data1) %in% "table")){**

**if(length(dim(data1)) > 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A 1D TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! any(class(data2) %in% c("logical", "integer", "numeric", "character", "factor", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT MUST BE A NON NULL VECTOR, FACTOR OR 1D TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(all(class(data2) %in% "table")){**

**if(length(dim(data2)) > 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT MUST BE A 1D TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) # activate this line and use the function to check arguments status*

*# end argument checking*

*# main code*

**same.class <- NULL**

**class <- NULL**

**same.length <- NULL**

**length <- NULL**

**same.levels <- NULL**

**levels <- NULL**

**any.id.levels <- NULL**

**same.levels.pos1 <- NULL**

**same.levels.pos2 <- NULL**

**common.levels <- NULL**

**same.name <- NULL**

**name <- NULL**

**any.id.name <- NULL**

**same.name.pos1 <- NULL**

**same.name.pos2 <- NULL**

**common.names <- NULL**

**any.id.element <- NULL**

**same.element.pos1 <- NULL**

**same.element.pos2 <- NULL**

**common.elements <- NULL**

**identical.object <- NULL**

**identical.content <- NULL**

**if(identical(data1, data2)){**

**same.class <- TRUE**

**class <- class(data1)**

**same.length <- TRUE**

**length <- length(data1)**

**if(any(class(data1) %in% "factor")){**

**same.levels <- TRUE**

**levels <- levels(data1)**

**any.id.levels <- TRUE**

**same.levels.pos1 <- 1:length(levels(data1))**

**same.levels.pos2 <- 1:length(levels(data2))**

**common.levels <- levels(data1)**

**}**

**if( ! is.null(names(data1))){**

**same.name <- TRUE**

**name <- names(data1)**

**any.id.name <- TRUE**

**same.name.pos1 <- 1:length(data1)**

**same.name.pos2 <- 1:length(data2)**

**common.names <- names(data1)**

**}**

**any.id.element <- TRUE**

**same.element.pos1 <- 1:length(data1)**

**same.element.pos2 <- 1:length(data2)**

**common.elements <- data1**

**identical.object <- TRUE**

**identical.content <- TRUE**

**}else{**

**identical.object <- FALSE**

**if( ! identical(class(data1), class(data2))){**

**same.class <- FALSE**

**}else{**

**same.class <- TRUE**

**class <- class(data1)**

**}**

**if( ! identical(length(data1), length(data2))){**

**same.length<- FALSE**

**}else{**

**same.length<- TRUE**

**length <- length(data1)**

**}**

**if(any(class(data1) %in% "factor") & any(class(data2) %in% "factor")){**

**if( ! identical(levels(data1), levels(data2))){**

**same.levels <- FALSE**

**}else{**

**same.levels <- TRUE**

**levels <- levels(data1)**

**}**

**any.id.levels <- FALSE**

**if(any(levels(data1) %in% levels(data2))){**

**any.id.levels <- TRUE**

**same.levels.pos1 <- which(levels(data1) %in% levels(data2))**

**}**

**if(any(levels(data2) %in% levels(data1))){**

**any.id.levels <- TRUE**

**same.levels.pos2 <- which(levels(data2) %in% levels(data1))**

**}**

**if(any.id.levels == TRUE){**

**common.levels <- unique(c(levels(data1)[same.levels.pos1], levels(data2)[same.levels.pos2]))**

**}**

**}**

**if(any(class(data1) %in% "factor")){** *# to compare content*

**data1 <- as.character(data1)**

**}**

**if(any(class(data2) %in% "factor")){** *# to compare content*

**data2 <- as.character(data2)**

**}**

**if( ! (is.null(names(data1)) & is.null(names(data2)))){**

**if( ! identical(names(data1), names(data2))){**

**same.name <- FALSE**

**}else{**

**same.name <- TRUE**

**name <- names(data1)**

**}**

**any.id.name <- FALSE**

**if(any(names(data1) %in% names(data2))){**

**any.id.name <- TRUE**

**same.name.pos1 <- which(names(data1) %in% names(data2))**

**}**

**if(any(names(data2) %in% names(data1))){**

**any.id.name <- TRUE**

**same.name.pos2 <- which(names(data2) %in% names(data1))**

**}**

**if(any.id.name == TRUE){**

**common.names <- unique(c(names(data1)[same.name.pos1], names(data2)[same.name.pos2]))**

**}**

**}**

**any.id.element <- FALSE**

**if(any(data1 %in% data2)){**

**any.id.element <- TRUE**

**same.element.pos1 <- which(data1 %in% data2)**

**}**

**if(any(data2 %in% data1)){**

**any.id.element <- TRUE**

**same.element.pos2 <- which(data2 %in% data1)**

**}**

**if(any.id.element == TRUE){**

**common.elements <- unique(c(data1[same.element.pos1], data2[same.element.pos2]))**

**}**

**if(same.length == TRUE & ! all(is.null(same.element.pos1), is.null(same.element.pos2))){**

**names(same.element.pos1) <- NULL**

**names(same.element.pos2) <- NULL**

**if(identical(same.element.pos1, same.element.pos2)){**

**identical.content <- TRUE**

**}else{**

**identical.content <- FALSE**

**}**

**}else{**

**identical.content <- FALSE**

**}**

**}**

**output <- list(same.class = same.class, class = class, same.length = same.length, length = length, same.levels = same.levels, levels = levels, any.id.levels = any.id.levels, same.levels.pos1 = same.levels.pos1, same.levels.pos2 = same.levels.pos2, common.levels = common.levels, same.name = same.name, name = name, any.id.name = any.id.name, same.name.pos1 = same.name.pos1, same.name.pos2 = same.name.pos2, common.names = common.names, any.id.element = any.id.element, same.element.pos1 = same.element.pos1, same.element.pos2 = same.element.pos2, common.elements = common.elements, identical.object = identical.object, identical.content = identical.content)**

**return(output)**

**}**

######## fun\_2d\_comp() #### comparison of two 2D datasets (row & col names, dimensions, etc.)

**# Check OK: clear to go Apollo**

**fun\_2d\_comp <- function(data1, data2){**

*# AIM*

*# compare two 2D datasets of the same class or not. Check and report in a list if the 2 datasets have:*

*# same class*

*# common row names*

*# common column names*

*# same row number*

*# same column number*

*# potential identical rows between the 2 datasets*

*# potential identical columns between the 2 datasets*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# none*

*# ARGUMENTS*

*# data1: matrix, data frame or table*

*# data2: matrix, data frame or table*

*# RETURN*

*# a list containing:*

*# $same.class: logical. Are class identical ?*

*# $class: classes of the 2 datasets (NULL otherwise)*

*# $same.dim: logical. Are dimension identical ?*

*# $dim: dimension of the 2 datasets (NULL otherwise)*

*# $same.row.nb: logical. Are number of rows identical ?*

*# $row.nb: nb of rows of the 2 datasets if identical (NULL otherwise)*

*# $same.col.nb: logical. Are number of columns identical ?*

*# $col.nb: nb of columns of the 2 datasets if identical (NULL otherwise)*

*# $same.row.name: logical. Are row names identical ? NULL if no row names in the two 2D datasets*

*# $row.name: name of rows of the 2 datasets if identical (NULL otherwise)*

*# $any.id.row.name: logical. Is there any row names identical ? NULL if no row names in the two 2D datasets*

*# $same.row.name.pos1: position, in data1, of the row names identical in data2*

*# $same.row.name.pos2: position, in data2, of the row names identical in data1*

*# $common.row.names: common row names between data1 and data2 (can be a subset of $name or not). NULL if no common row names*

*# $same.col.name: logical. Are column names identical ? NULL if no col names in the two 2D datasets*

*# $col.name: name of columns of the 2 datasets if identical (NULL otherwise)*

*# $any.id.col.name: logical. Is there any column names identical ? NULL if no col names in the two 2D datasets*

*# $same.col.name.pos1: position, in data1, of the column names identical in data2*

*# $same.col.name.pos2: position, in data2, of the column names identical in data1*

*# $common.col.names: common column names between data1 and data2 (can be a subset of $name or not). NULL if no common column names*

*# $any.id.row: logical. is there identical rows (not considering row names) ?*

*# $same.row.pos1: position, in data1, of the rows identical in data2 (not considering row names)*

*# $same.row.pos2: position, in data2, of the rows identical in data1 (not considering row names)*

*# $any.id.col: logical. is there identical columns (not considering column names)?*

*# $same.col.pos1: position in data1 of the cols identical in data2 (not considering column names)*

*# $same.col.pos2: position in data2 of the cols identical in data1 (not considering column names)*

*# $identical.object: logical. Are objects identical (including row & column names)?*

*# $identical.content: logical. Are content objects identical (identical excluding row & column names)?*

*# EXAMPLES*

*# obs1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; obs2 = as.data.frame(matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5]))) ; obs1 ; obs2 ; fun\_2d\_comp(obs1, obs2)*

*# obs1 = matrix(101:110, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; obs2 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; obs1 ; obs2 ; fun\_2d\_comp(obs1, obs2)*

*# obs1 = matrix(1:10, byrow = TRUE, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; obs2 = matrix(c(1:5, 101:105, 6:10), byrow = TRUE, ncol = 5, dimnames = list(c("a", "z", "b"), c(LETTERS[1:2], "k", LETTERS[5:4]))) ; obs1 ; obs2 ; fun\_2d\_comp(obs1, obs2)*

*# obs1 = t(matrix(1:10, byrow = TRUE, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5]))) ; obs2 = t(matrix(c(1:5, 101:105, 6:10), byrow = TRUE, ncol = 5, dimnames = list(c("a", "z", "b"), c(LETTERS[1:2], "k", LETTERS[5:4])))) ; obs1 ; obs2 ; fun\_2d\_comp(obs1, obs2)*

*# DEBUGGING*

*# data1 = matrix(1:10, ncol = 5) ; data2 = matrix(1:10, ncol = 5) # for function debugging*

*# data1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; data2 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# data1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; data2 = matrix(1:10, ncol = 5) # for function debugging*

*# data1 = matrix(1:15, byrow = TRUE, ncol = 5, dimnames = list(letters[1:3], LETTERS[1:5])) ; data2 = matrix(1:10, byrow = TRUE, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# data1 = matrix(1:15, ncol = 5, dimnames = list(letters[1:3], LETTERS[1:5])) ; data2 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# data1 = matrix(1:15, ncol = 5, dimnames = list(paste0("A", letters[1:3]), LETTERS[1:5])) ; data2 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# data1 = matrix(1:15, ncol = 5, dimnames = list(letters[1:3], LETTERS[1:5])) ; data2 = matrix(1:12, ncol = 4, dimnames = list(letters[1:3], LETTERS[1:4])) # for function debugging*

*# data1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; data2 = matrix(101:110, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# data1 = data.frame(a = 1:3, b= letters[1:3], row.names = LETTERS[1:3]) ; data2 = data.frame(A = 1:3, B= letters[1:3]) # for function debugging*

*# data1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; data2 = as.data.frame(matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5]))) # for function debugging*

*# data1 = matrix(1:10, byrow = TRUE, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; data2 = matrix(c(1:5, 101:105, 6:10), byrow = TRUE, ncol = 5, dimnames = list(c("a", "z", "b"), c(LETTERS[1:2], "k", LETTERS[5:4]))) # for function debugging*

*# data1 = table(Exp1 = c("A", "A", "A", "B", "B", "B"), Exp2 = c("A1", "B1", "A1", "C1", "C1", "B1")) ; data2 = data.frame(A = 1:3, B= letters[1:3]) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# argument checking*

**if( ! any(class(data1) %in% c("matrix", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A MATRIX, DATA FRAME OR TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! any(class(data2) %in% c("matrix", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT MUST BE A MATRIX, DATA FRAME OR TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) # activate this line and use the function to check arguments status*

*# end argument checking*

*# main code*

**same.class <- NULL**

**class <- NULL**

**same.dim <- NULL**

**dim <- NULL**

**same.row.nb <- NULL**

**row.nb <- NULL**

**same.col.nb <- NULL**

**col.nb <- NULL**

**same.row.name <- NULL**

**row.name <- NULL**

**any.id.row.name <- NULL**

**same.row.name.pos1 <- NULL**

**same.row.name.pos2 <- NULL**

**common.row.names <- NULL**

**same.col.name <- NULL**

**any.id.col.name <- NULL**

**same.col.name.pos1 <- NULL**

**same.col.name.pos2 <- NULL**

**common.col.names <- NULL**

**col.name <- NULL**

**any.id.row <- NULL**

**same.row.pos1 <- NULL**

**same.row.pos2 <- NULL**

**any.id.col <- NULL**

**same.col.pos1 <- NULL**

**same.col.pos2 <- NULL**

**identical.object <- NULL**

**identical.content <- NULL**

**if(identical(data1, data2) & any(class(data1) %in% c("matrix", "data.frame", "table"))){**

**same.class <- TRUE**

**class <- class(data1)**

**same.dim <- TRUE**

**dim <- dim(data1)**

**same.row.nb <- TRUE**

**row.nb <- nrow(data1)**

**same.col.nb <- TRUE**

**col.nb <- ncol(data1)**

**same.row.name <- TRUE**

**row.name <- dimnames(data1)[[1]]**

**any.id.row.name <- TRUE**

**same.row.name.pos1 <- 1:row.nb**

**same.row.name.pos2 <- 1:row.nb**

**common.row.names <- dimnames(data1)[[1]]**

**same.col.name <- TRUE**

**col.name <- dimnames(data1)[[2]]**

**any.id.col.name <- TRUE**

**same.col.name.pos1 <- 1:col.nb**

**same.col.name.pos2 <- 1:col.nb**

**common.col.names <- dimnames(data1)[[2]]**

**any.id.row <- TRUE**

**same.row.pos1 <- 1:row.nb**

**same.row.pos2 <- 1:row.nb**

**any.id.col <- TRUE**

**same.col.pos1 <- 1:col.nb**

**same.col.pos2 <- 1:col.nb**

**identical.object <- TRUE**

**identical.content <- TRUE**

**}else{**

**identical.object <- FALSE**

**if(all(class(data1) == "table") & length(dim(data1)) == 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT IS A 1D TABLE. USE THE info\_1D\_dataset\_fun FUNCTION\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(all(class(data2) == "table") & length(dim(data2)) == 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT IS A 1D TABLE. USE THE info\_1D\_dataset\_fun FUNCTION\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! identical(class(data1), class(data2))){**

**same.class <- FALSE**

**}else if( ! any(class(data1) %in% c("matrix", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 AND data2 ARGUMENTS MUST BE EITHER MATRIX, DATA FRAME OR TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**same.class <- TRUE**

**class <- class(data1)**

**}**

**if( ! identical(dim(data1), dim(data2))){**

**same.dim <- FALSE**

**}else{**

**same.dim <- TRUE**

**dim <- dim(data1)**

**}**

**if( ! identical(nrow(data1), nrow(data2))){**

**same.row.nb <- FALSE**

**}else{**

**same.row.nb <- TRUE**

**row.nb <- nrow(data1)**

**}**

**if( ! identical(ncol(data1), ncol(data2))){**

**same.col.nb <- FALSE**

**}else{**

**same.col.nb <- TRUE**

**col.nb <- ncol(data1)**

**}**

*# row and col names*

**if(is.null(dimnames(data1)) & is.null(dimnames(data2))){**

**same.row.name <- NULL**

**same.col.name <- NULL**

*# row and col names remain NULL*

**}else if((is.null(dimnames(data1)) & ! is.null(dimnames(data2))) | ( ! is.null(dimnames(data1)) & is.null(dimnames(data2)))){**

**same.row.name <- FALSE**

**same.col.name <- FALSE**

*# row and col names remain NULL*

**}else{**

**if( ! identical(dimnames(data1)[[1]], dimnames(data2)[[1]])){**

**same.row.name <- FALSE**

*# row names remain NULL*

**}else{**

**same.row.name <- TRUE**

**row.name <- dimnames(data1)[[1]]**

**}**

*# row names*

**any.id.row.name <- FALSE**

**if(any(dimnames(data1)[[1]] %in% dimnames(data2)[[1]])){**

**any.id.row.name <- TRUE**

**same.row.name.pos1 <- which(dimnames(data1)[[1]] %in% dimnames(data2)[[1]])**

**}**

**if(any(dimnames(data2)[[1]] %in% dimnames(data1)[[1]])){**

**any.id.row.name <- TRUE**

**same.row.name.pos2 <- which(dimnames(data2)[[1]] %in% dimnames(data1)[[1]])**

**}**

**if(any.id.row.name == TRUE){**

**common.row.names <- unique(c(dimnames(data1)[[1]][same.row.name.pos1], dimnames(data2)[[1]][same.row.name.pos2]))**

**}**

*# col names*

**any.id.col.name <- FALSE**

**if(any(dimnames(data1)[[2]] %in% dimnames(data2)[[2]])){**

**any.id.col.name <- TRUE**

**same.col.name.pos1 <- which(dimnames(data1)[[2]] %in% dimnames(data2)[[2]])**

**}**

**if(any(dimnames(data2)[[2]] %in% dimnames(data1)[[2]])){**

**any.id.col.name <- TRUE**

**same.col.name.pos2 <- which(dimnames(data2)[[2]] %in% dimnames(data1)[[2]])**

**}**

**if(any.id.col.name == TRUE){**

**common.col.names <- unique(c(dimnames(data1)[[2]][same.col.name.pos1], dimnames(data2)[[2]][same.col.name.pos2]))**

**}**

**if( ! identical(dimnames(data1)[[2]], dimnames(data2)[[2]])){**

**same.col.name <- FALSE**

*# col names remain NULL*

**}else{**

**same.col.name <- TRUE**

**col.name <- dimnames(data1)[[2]]**

**}**

**}**

*# identical row and col content*

**if(all(class(data1) == "table")){**

**as.data.frame(matrix(data1, ncol = ncol(data1)), stringsAsFactors = FALSE)**

**}else if(all(class(data1) == "matrix")){**

**data1 <- as.data.frame(data1, stringsAsFactors = FALSE)**

**}else if(all(class(data1) == "data.frame")){**

**data1 <- data.frame(lapply(data1, as.character), stringsAsFactors=FALSE)**

**}**

**if(all(class(data2) == "table")){**

**as.data.frame(matrix(data2, ncol = ncol(data2)), stringsAsFactors = FALSE)**

**}else if(all(class(data2) == "matrix")){**

**data2 <- as.data.frame(data2, stringsAsFactors = FALSE)**

**}else if(all(class(data2) == "data.frame")){**

**data2 <- data.frame(lapply(data2, as.character), stringsAsFactors=FALSE)**

**}**

**row.names(data1) <- paste0("A", 1:nrow(data1))**

**row.names(data2) <- paste0("A", 1:nrow(data2))**

**if(same.col.nb == TRUE){** *# because if not the same col nb, the row cannot be identical*

**same.row.pos1 <- which(c(as.data.frame(t(data1), stringsAsFactors = FALSE)) %in% c(as.data.frame(t(data2), stringsAsFactors = FALSE)))**

**same.row.pos2 <- which(c(as.data.frame(t(data2), stringsAsFactors = FALSE)) %in% c(as.data.frame(t(data1), stringsAsFactors = FALSE)))**

**names(same.row.pos1) <- NULL**

**names(same.row.pos2) <- NULL**

**if(all(is.na(same.row.pos1))){**

**same.row.pos1 <- NULL**

**}else{**

**same.row.pos1 <- same.row.pos1[ ! is.na(same.row.pos1)]**

**any.id.row <- TRUE**

**}**

**if(all(is.na(same.row.pos2))){**

**same.row.pos2 <- NULL**

**}else{**

**same.row.pos2 <- same.row.pos2[ ! is.na(same.row.pos2)]**

**any.id.row <- TRUE**

**}**

**if(is.null(same.row.pos1) & is.null(same.row.pos2)){**

**any.id.row <- FALSE**

**}**

**}else{**

**any.id.row <- FALSE**

*# same.row.pos1 and 2 remain NULL*

**}**

**if(same.row.nb == TRUE){** *# because if not the same row nb, the col cannot be identical*

**same.col.pos1 <- which(c(data1) %in% c(data2))**

**same.col.pos2 <- which(c(data2) %in% c(data1))**

**names(same.col.pos1) <- NULL**

**names(same.col.pos2) <- NULL**

**if(all(is.na(same.col.pos1))){**

**same.col.pos1 <- NULL**

**}else{**

**same.col.pos1 <- same.col.pos1[ ! is.na(same.col.pos1)]**

**any.id.col <- TRUE**

**}**

**if(all(is.na(same.col.pos2))){**

**same.col.pos2 <- NULL**

**}else{**

**same.col.pos2 <- same.col.pos2[ ! is.na(same.col.pos2)]**

**any.id.col <- TRUE**

**}**

**if(is.null(same.col.pos1) & is.null(same.col.pos2)){**

**any.id.col <- FALSE**

**}**

**}else{**

**any.id.col <- FALSE**

*# same.col.pos1 and 2 remain NULL*

**}**

**if(same.dim == TRUE & ! all(is.null(same.row.pos1), is.null(same.row.pos2), is.null(same.col.pos1), is.null(same.col.pos2))){** *# same.dim == TRUE means that same.row.nb == TRUE and same.col.nb == TRUE, meaning that row.nb != NULL and col.nb != NULL. Thus, no need to include these checkings*

**if(identical(same.row.pos1, 1:row.nb) & identical(same.row.pos2, 1:row.nb) & identical(same.col.pos1, 1:col.nb) & identical(same.col.pos2, 1:col.nb)){**

**identical.content <- TRUE**

**}else{**

**identical.content <- FALSE**

**}**

**}else{**

**identical.content <- FALSE**

**}**

**}**

**output <- list(same.class = same.class, class = class, same.dim = same.dim, dim = dim, same.row.nb = same.row.nb, row.nb = row.nb, same.col.nb = same.col.nb , col.nb = col.nb, same.row.name = same.row.name, row.name = row.name, any.id.row.name = any.id.row.name, same.row.name.pos1 = same.row.name.pos1, same.row.name.pos2 = same.row.name.pos2, common.row.names = common.row.names, same.col.name = same.col.name, col.name = col.name,any.id.col.name = any.id.col.name, same.col.name.pos1 = same.col.name.pos1, same.col.name.pos2 = same.col.name.pos2, common.col.names = common.col.names, any.id.row = any.id.row, same.row.pos1 = same.row.pos1, same.row.pos2 = same.row.pos2, any.id.col = any.id.col, same.col.pos1 = same.col.pos1, same.col.pos2 = same.col.pos2, identical.object = identical.object, identical.content = identical.content)**

**return(output)**

**}**

######## fun\_2d\_head() #### head of the left or right of big 2D objects

**# Check OK: clear to go Apollo**

**fun\_2d\_head <- function(data1, n = 10, side = "l"){**

*# AIM*

*# display the head of the left or right of big 2D objects*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data1: matrix, data frame or table*

*# n: number of dimension to print (10 means 10 rows and columns)*

*# side: either "l" or "r" for the left or right side of the 2D object*

*# RETURN*

*# the head*

*# EXAMPLES*

*# obs1 = matrix(1:30, ncol = 5, dimnames = list(letters[1:6], LETTERS[1:5])) ; obs1 ; fun\_2d\_head(obs1, 3)*

*# obs1 = matrix(1:30, ncol = 5, dimnames = list(letters[1:6], LETTERS[1:5])) ; obs1 ; fun\_2d\_head(obs1, 3, "right")*

*# DEBUGGING*

*# data1 = matrix(1:30, ncol = 5) # for function debugging*

*# data1 = matrix(1:30, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if( ! any(class(data1) %in% c("matrix", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A MATRIX, DATA FRAME OR TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = n, class = "vector", typeof = "integer", double.as.integer.allowed = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = side, options = c("l", "r"), length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**obs.dim <- dim(data1)**

**row <- 1:ifelse(obs.dim[1] < n, obs.dim[1], n)**

**if(side == "l"){**

**col <- 1:ifelse(obs.dim[2] < n, obs.dim[2], n)**

**}**

**if(side == "r"){**

**col <- ifelse(obs.dim[2] < n, 1, obs.dim[2] - n + 1):obs.dim[2]**

**}**

**return(data1[row, col])**

**}**

######## fun\_2d\_tail() #### tail of the left or right of big 2D objects

**# Check OK: clear to go Apollo**

**fun\_2d\_tail <- function(data1, n = 10, side = "l"){**

*# AIM*

*# display the tail of the left or right of big 2D objects*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data1: matrix, data frame or table*

*# n: number of dimension to print (10 means 10 rows and columns)*

*# side: either "l" or "r" for the left or right side of the 2D object*

*# RETURN*

*# the tail*

*# EXAMPLES*

*# obs1 = matrix(1:30, ncol = 5, dimnames = list(letters[1:6], LETTERS[1:5])) ; obs1 ; fun\_2d\_tail(obs1, 3)*

*# obs1 = matrix(1:30, ncol = 5, dimnames = list(letters[1:6], LETTERS[1:5])) ; obs1 ; fun\_2d\_tail(obs1, 3, "r")*

*# DEBUGGING*

*# data1 = matrix(1:10, ncol = 5) # for function debugging*

*# data1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if( ! any(class(data1) %in% c("matrix", "data.frame", "table"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A MATRIX, DATA FRAME OR TABLE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = n, class = "vector", typeof = "integer", double.as.integer.allowed = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = side, options = c("l", "r"), length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**obs.dim <- dim(data1)**

**row <- ifelse(obs.dim[1] < n, 1, obs.dim[1] - n + 1):obs.dim[1]**

**if(side == "l"){**

**col <- 1:ifelse(obs.dim[2] < n, obs.dim[2], n)**

**}**

**if(side == "r"){**

**col <- ifelse(obs.dim[2] < n, 1, obs.dim[2] - n + 1):obs.dim[2]**

**}**

**return(data1[row, col])**

**}**

######## fun\_list\_comp() #### comparison of two lists

**# Check OK: clear to go Apollo**

**fun\_list\_comp <- function(data1, data2){**

*# AIM*

*# compare two lists. Check and report in a list if the 2 datasets have:*

*# same length*

*# common names*

*# common compartments*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# none*

*# ARGUMENTS*

*# data1: list*

*# data2: list*

*# RETURN*

*# a list containing:*

*# $same.length: logical. Are number of elements identical?*

*# $length: number of elements in the 2 datasets (NULL otherwise)*

*# $same.name: logical. Are element names identical ?*

*# $name: name of elements of the 2 datasets if identical (NULL otherwise)*

*# $any.id.name: logical. Is there any element names identical ?*

*# $same.name.pos1: position, in data1, of the element names identical in data2*

*# $same.name.pos2: position, in data2, of the compartment names identical in data1*

*# $any.id.compartment: logical. is there any identical compartments ?*

*# $same.compartment.pos1: position, in data1, of the compartments identical in data2*

*# $same.compartment.pos2: position, in data2, of the compartments identical in data1*

*# $identical.object: logical. Are objects identical (kind of object, compartment names and content)?*

*# $identical.content: logical. Are content objects identical (identical compartments excluding compartment names)?*

*# EXAMPLES*

*# obs1 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) ; obs2 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) ; fun\_list\_comp(obs1, obs2)*

*# obs1 = list(1:5, LETTERS[1:2]) ; obs2 = list(a = 1:5, b = LETTERS[1:2]) ; fun\_list\_comp(obs1, obs2)*

*# obs1 = list(b = 1:5, c = LETTERS[1:2]) ; obs2 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) ; fun\_list\_comp(obs1, obs2)*

*# obs1 = list(b = 1:5, c = LETTERS[1:2]) ; obs2 = list(LETTERS[5:9], matrix(1:6), 1:5) ; fun\_list\_comp(obs1, obs2)*

*# DEBUGGING*

*# data1 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) ; data2 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) # for function debugging*

*# data1 = list(a = 1:5, b = LETTERS[1:2]) ; data2 = list(a = 1:5, b = LETTERS[1:2], d = matrix(1:6)) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# argument checking*

**if( ! any(class(data1) %in% "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! any(class(data2) %in% "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT MUST BE A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) # activate this line and use the function to check arguments status*

*# end argument checking*

*# main code*

**same.length <- NULL**

**length <- NULL**

**same.name <- NULL**

**name <- NULL**

**any.id.name <- NULL**

**same.name.pos1 <- NULL**

**same.name.pos2 <- NULL**

**any.id.compartment <- NULL**

**same.compartment.pos1 <- NULL**

**same.compartment.pos2 <- NULL**

**identical.object <- NULL**

**identical.content <- NULL**

**if(identical(data1, data2)){**

**same.length <- TRUE**

**length <- length(data1)**

**if( ! is.null(names(data1))){**

**same.name <- TRUE**

**name <- names(data1)**

**any.id.name <- TRUE**

**same.name.pos1 <- 1:length(data1)**

**same.name.pos2 <- 1:length(data2)**

**}**

**any.id.compartment <- TRUE**

**same.compartment.pos1 <- 1:length(data1)**

**same.compartment.pos2 <- 1:length(data2)**

**identical.object <- TRUE**

**identical.content <- TRUE**

**}else{**

**identical.object <- FALSE**

**if( ! identical(length(data1), length(data2))){**

**same.length<- FALSE**

**}else{**

**same.length<- TRUE**

**length <- length(data1)**

**}**

**if( ! (is.null(names(data1)) & is.null(names(data2)))){**

**if( ! identical(names(data1), names(data2))){**

**same.name <- FALSE**

**}else{**

**same.name <- TRUE**

**name <- names(data1)**

**}**

**any.id.name <- FALSE**

**if(any(names(data1) %in% names(data2))){**

**any.id.name <- TRUE**

**same.name.pos1 <- which(names(data1) %in% names(data2))**

**}**

**if(any(names(data2) %in% names(data1))){**

**any.id.name <- TRUE**

**same.name.pos2 <- which(names(data2) %in% names(data1))**

**}**

**}**

**names(data1) <- NULL**

**names(data2) <- NULL**

**any.id.compartment <- FALSE**

**if(any(data1 %in% data2)){**

**any.id.compartment <- TRUE**

**same.compartment.pos1 <- which(data1 %in% data2)**

**}**

**if(any(data2 %in% data1)){**

**any.id.compartment <- TRUE**

**same.compartment.pos2 <- which(data2 %in% data1)**

**}**

**if(same.length == TRUE & ! all(is.null(same.compartment.pos1), is.null(same.compartment.pos2))){**

**if(identical(same.compartment.pos1, same.compartment.pos2)){**

**identical.content <- TRUE**

**}else{**

**identical.content <- FALSE**

**}**

**}else{**

**identical.content <- FALSE**

**}**

**}**

**output <- list(same.length = same.length, length = length, same.name = same.name, name = name, any.id.name = any.id.name, same.name.pos1 = same.name.pos1, same.name.pos2 = same.name.pos2, any.id.compartment = any.id.compartment, same.compartment.pos1 = same.compartment.pos1, same.compartment.pos2 = same.compartment.pos2, identical.object = identical.object, identical.content = identical.content)**

**return(output)**

**}**

################ Object modification

######## fun\_name\_change() #### check a vector of character strings and modify any string if present in another vector

**# Check OK: clear to go Apollo**

**fun\_name\_change <- function(data1, data2, added.string = "\_modif"){**

*# AIM*

*# this function allow to check if a vector of character strings, like column names of a data frame, has elements present in another vector (vector of reserved words or column names of another data frame before merging)*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data1: vector of character strings to check and modify*

*# data2: reference vector of character strings*

*# added.string: string added at the end of the modified string in data1 if present in data2*

*# RETURN*

*# a list containing*

*# $data: the modified or unmodified data1 (in the same order as in the initial data1)*

*# $ini: the initial elements before modification. NULL if no modification*

*# $post: the modified elements in the same order as in ini. NULL if no modification*

*# EXAMPLES*

*# obs1 <- c("A", "B", "C", "D") ; obs2 <- c("A", "C") ; fun\_name\_change(obs1, obs2)*

*# obs1 <- c("A", "B", "C", "C\_modif1", "D") ; obs2 <- c("A", "A\_modif1", "C") ; fun\_name\_change(obs1, obs2) # the function checks that the new names are neither in obs1 nor in obs2 (increment the number after the added string)*

*# DEBUGGING*

*# data1 = c("A", "B", "C", "D") ; data2 <- c("A", "C") ; added.string = "\_modif" # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data1, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = data2, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = added.string, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**ini <- NULL**

**post <- NULL**

**if(any(data1 %in% data2)){**

**tempo.names <- data1[data1 %in% data2]**

**ini <- NULL**

**post <- NULL**

**for(i3 in 1:length(tempo.names)){**

**count <- 0**

**tempo <- tempo.names[i3]**

**while(any(tempo %in% data2) | any(tempo %in% data1)){**

**count <- count + 1**

**tempo <- paste0(tempo.names[i3], "\_modif", count)**

**}**

**data1[data1 %in% tempo.names[i3]] <- paste0(tempo.names[i3], "\_modif", count)**

**if(count != 0){**

**ini <- c(ini, tempo.names[i3])**

**post <- c(post, paste0(tempo.names[i3], "\_modif", count))**

**}**

**}**

**data <- data1**

**}else{**

**data <- data1**

**}**

**output <- list(data = data, ini = ini, post = post)**

**return(output)**

**}**

######## fun\_df\_remod() #### remodeling a data frame to have column name as a qualitative values and vice-versa

**# Check OK: clear to go Apollo**

**fun\_df\_remod <- function(data, quanti.col.name = "quanti", quali.col.name = "quali"){**

*# AIM*

*# if the data frame is made of numeric columns, a new data frame is created, with the 1st column gathering all the numeric values, and the 2nd column being the name of the columns of the initial data frame. If row names were present in the initial data frame, then a new ini\_rowname column is added with the names of the rows*



*# If the data frame is made of one numeric column and one character or factor column, a new data frame is created, with the new columns corresponding to the split numeric values (according to the character column). NA are added a the end of each column to have the same number of rows. BEWARE: in such data frame, rows are not individuals. This means that in the example below, values 10 and 20 are associated on the same row but that means nothing in term of association*



*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data: data frame to convert*

*# quanti.col.name: optional name for the quanti column of the new data frame*

*# quali.col.name: optional name for the quali column of the new data frame*

*# RETURN*

*# the modified data frame*

*# EXAMPLES*

*# obs <- data.frame(col1 = (1:4)\*10, col2 = c("A", "B", "A", "A")) ; obs ; fun\_df\_remod(obs)*

*# obs <- data.frame(col1 = (1:4)\*10, col2 = 5:8) ; obs ; fun\_df\_remod(obs, quanti.col.name = "quanti", quali.col.name = "quali")*

*# obs <- data.frame(col1 = (1:4)\*10, col2 = 5:8) ; rownames(obs) <- paste0("row", 1:4) ; obs ; fun\_df\_remod(obs, quanti.col.name = "quanti", quali.col.name = "quali")*

*# DEBUGGING*

*# data = data.frame(a = 1:3, b = 4:6) ; quanti.col.name = "quanti" ; quali.col.name = "quali" # for function debugging*

*# data = data.frame(a = 1:3, b = 4:6, c = 11:13) ; quanti.col.name = "quanti" ; quali.col.name = "quali" # for function debugging*

*# data = data.frame(a = 1:3, b = letters[1:3]) ; quanti.col.name = "quanti" ; quali.col.name = "quali" # for function debugging*

*# data = data.frame(a = 1:3, b = letters[1:3]) ; quanti.col.name = "TEST" ; quali.col.name = "quali" # for function debugging*

*# data = data.frame(b = letters[1:3], a = 1:3) ; quanti.col.name = "quanti" ; quali.col.name = "quali" # for function debugging*

*# data = data.frame(b = c("e", "e", "h"), a = 1:3) ; quanti.col.name = "quanti" ; quali.col.name = "quali" # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if( ! any(class(data) %in% "data.frame")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data ARGUMENT MUST BE A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = quanti.col.name, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = quali.col.name, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**tempo.factor <- unlist(lapply(data, class))**

**for(i in 1:length(tempo.factor)){** *# convert factor columns as character*

**if(all(tempo.factor[i] == "factor")){**

**data[, i] <- as.character(data[, i])**

**}**

**}**

**tempo.factor <- unlist(lapply(data, mode))**

**if(length(data) == 2){**

**if( ! ((mode(data[, 1]) == "character" & mode(data[, 2]) == "numeric") | mode(data[, 2]) == "character" & mode(data[, 1]) == "numeric" | mode(data[, 2]) == "numeric" & mode(data[, 1]) == "numeric") ){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": IF data ARGUMENT IS A DATA FRAME MADE OF 2 COLUMNS, EITHER A COLUMN MUST BE NUMERIC AND THE OTHER CHARACTER, OR THE TWO COLUMNS MUST BE NUMERIC\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if((mode(data[, 1]) == "character" | mode(data[, 2]) == "character") & (quanti.col.name != "quanti" | quali.col.name != "quali")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": IMPROPER quanti.col.name OR quali.col.name RESETTINGS. THESE ARGUMENTS ARE RESERVED FOR DATA FRAMES MADE OF n NUMERIC COLUMNS ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}else{**

**if( ! all(tempo.factor %in% "numeric")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": IF data ARGUMENT IS A DATA FRAME MADE OF ONE COLUMN, OR MORE THAN 2 COLUMNS, THESE COLUMNS MUST BE NUMERIC\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if(( ! any(tempo.factor %in% "character")) & is.null(names(data))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": NUMERIC DATA FRAME in the data ARGUMENT MUST HAVE COLUMN NAMES\n\n================\n\n")**

**stop()**

**}**

**if(all(tempo.factor %in% "numeric")){** *# transfo 1*

**quanti <- NULL**

**for(i in 1:length(data)){**

**quanti <-c(quanti, data[, i])**

**}**

**quali <- rep(names(data), each = nrow(data))**

**output.data <- data.frame(quanti, quali)**

**names(output.data) <- c(quanti.col.name, quali.col.name)**

*# add the ini\_rowname column*

**ini.rownames <- rownames(data)**

**tempo.data <- data**

**rownames(tempo.data) <- NULL**

**null.rownames <- (tempo.data)**

**if( ! identical(ini.rownames, null.rownames)){**

**ini\_rowname <- rep(ini.rownames, times = ncol(data))**

**output.data <- cbind(output.data, ini\_rowname)**

**}**

**}else{** *# transfo 2*

**if(class(data[, 1]) == "character"){**

**data <- cbind(data[2], data[1])**

**}**

**nc.max <- max(table(data[, 2]))** *# effectif maximum des classes*

**nb.na <- nc.max - table(data[,2])** *# nombre de NA à ajouter pour réaliser la data frame*

**tempo<-split(data[, 1], data[, 2])**

**for(i in 1:length(tempo)){tempo[[i]] <- append(tempo[[i]], rep(NA, nb.na[i]))}** *# des NA doivent être ajoutés lorsque les effectifs sont différents entre les classes. C'est uniquement pour que chaque colonne ait le même nombre de lignes*

**output.data<-data.frame(tempo)**

**}**

**return(output.data)**

**}**

######## fun\_merge() #### merge the columns of two 2D objects, by common rows

**fun\_merge <- function(data1, data2, name1, name2, factor.as = "numeric", warn.print = FALSE){**

*# AIM*

*# merge the columns of 2 data frames or 2 matrices or 2 tables, by associating the rows according to 1 or several common colums that must be strictly similar between the 2 objects*

*# contrary to the classical merge() function of R, fun\_merge() orders the rows of the 2 objects according to the common columns, and merge only and only if the ordered common columns are strictly identical. Otherwise return an error*

*# keep row names of data1 in the merged object if they exist. Do not consider row names of data2*

*# keep the intial row order of data1 after merging*

*# BEWARE:*

*# REQUIRED PACKAGES*

*# none*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_2d\_comp()*

*# fun\_check()*

*# ARGUMENTS*

*# data1: matrix or data frame or table*

*# data2: same class of object as data1 (data frame for data1 data frame, matrix for data1 matrix and table for data1 table) with same number of rows as in data1*

*# name1: either a vector of character strings or a vector of integer. If character strings, they must be the name of the columns in data1 that are common to the columns in data2. If integers, they must be the column numbers in data1 that are common to column numbers in data2. name1 can be strings and name2 (below) integers, and vice-versa. BEWARE: order of the elements in data1 are important as ordering is according to the first element, then the second, etc.*

*# name2: as in name1 but for data2. Order in name2 is not important as order in name1 is used for the ordering*

*# factor.as: either "numeric" (sort factors according to levels order, i.e., class number) or "character" (sort factors according to alphabetical order)*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# RETURN*

*# a list containing:*

*# $data: the merged data frame or matrix or table*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# obs1 = matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5])) ; obs2 = as.data.frame(matrix(1:10, ncol = 5, dimnames = list(letters[1:2], LETTERS[1:5]))) ; obs1 ; obs2 ; fun\_2d\_comp(obs1, obs2)*

*# DEBUGGING*

*# data1 = matrix(1.0001:21, ncol = 4) ; dimnames(data1) <- list(LETTERS[1:5], letters[1:4]); data2 = matrix(1.0001:31, ncol = 6) ; dimnames(data2) <- list(NULL, c("a", "aa", "c", "d", "aaa", "aaaa")) ; set.seed(1) ; data2[, "c"] <- sample(data2[, "c"]) ; data2[, "d"] <- sample(data2[, "d"]) ; set.seed(NULL) ; data1 ; data2 ; name1 = c("c", "d") ; name2 = c("d", "c") ; factor.as = "numeric" # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking using fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo1 <- fun\_check(data = data1, class = "matrix", print = FALSE)**

**tempo2 <- fun\_check(data = data1, class = "data.frame", print = FALSE)**

**tempo3 <- fun\_check(data = data1, class = "table", print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE & tempo3$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\ndata1 ARGUMENT MUST BE A 2D OBJECT (MATRIX, DATA FRAME OR TABLE)\nHERE IT IS: ", paste(class(data1), collapse = " "), "\n\n================\n\n")** *#*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo1 <- fun\_check(data = data2, class = "matrix", print = FALSE)**

**tempo2 <- fun\_check(data = data2, class = "data.frame", print = FALSE)**

**tempo3 <- fun\_check(data = data2, class = "table", print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE & tempo3$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\ndata2 ARGUMENT MUST BE A 2D OBJECT (MATRIX, DATA FRAME OR TABLE)\nHERE IT IS: ", paste(class(data2), collapse = " "), "\n\n================\n\n")** *#*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! identical(class(data1), class(data2))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\ndata1 and data2 ARGUMENTS MUST BE A 2D OBJECT (MATRIX, DATA FRAME OR TABLE) OF SAME CLASS\nHERE IT IS RESPECTIVELY: ", paste(class(data1), collapse = " "), " AND ", paste(class(data2), collapse = " "), "\n\n================\n\n")** *#*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo1 <- fun\_check(data = name1, class = "vector", typeof = "integer", , double.as.integer.allowed = TRUE, print = FALSE)**

**tempo2 <- fun\_check(data = name1, class = "vector", typeof = "character", , print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nname1 ARGUMENT MUST BE A UNIQUE CHARACTER STRING OR INTEGER\nHERE IT IS: ", paste(name1, collapse = " "), "\n\n================\n\n")** *#*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo1 <- fun\_check(data = name2, class = "vector", typeof = "integer", , double.as.integer.allowed = TRUE, print = FALSE)**

**tempo2 <- fun\_check(data = name2, class = "vector", typeof = "character", , print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nname2 ARGUMENT MUST BE A UNIQUE CHARACTER STRING OR INTEGER\nHERE IT IS: ", paste(name2, collapse = " "), "\n\n================\n\n")** *#*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = factor.as, options = c("numeric", "character"), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = warn.print, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking using fun\_check()*

*# other argument checking*

*# column existence*

**if(mode(name1) == "character"){**

**if( ! all(name1 %in% colnames(data1))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nTHE CHARACTER STRINGS IN name1 ARGUMENT ARE NOT ALL COLUMN NAMES OF data1:\n", paste(name1, collapse = " "), "\n", colnames(data1), "\n\n================\n\n")** *#*

**stop(tempo.cat)**

**}**

**}else if(mode(name1) == "numeric"){**

**if( ! all((name1 > ncol(data1) & name1 <= 0))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nINTEGERS IN name1 ARGUMENT ARE NOT ALL COLUMN NUMBERS OF data1:\n", paste(name1, collapse = " "), "\n1:", ncol(data1), "\n\n================\n\n")** *#*

**stop(tempo.cat)**

**}**

**}else{**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 1\n\n============\n\n")**

**stop(tempo.cat)**

**}**

**if(mode(name2) == "character"){**

**if( ! all(name2 %in% colnames(data2))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nTHE CHARACTER STRINGS IN name2 ARGUMENT ARE NOT ALL COLUMN NAMES OF data2:\n", paste(name2, collapse = " "), "\n", colnames(data2), "\n\n================\n\n")** *#*

**stop(tempo.cat)**

**}**

**}else if(mode(name2) == "numeric"){**

**if( ! all((name2 > ncol(data2) & name2 <= 0))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ":\nINTEGERS IN name2 ARGUMENT ARE NOT ALL COLUMN NUMBERS OF data2:\n", paste(name2, collapse = " "), "\n1:", ncol(data2), "\n\n================\n\n")** *#*

**stop(tempo.cat)**

**}**

**}else{**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\n\n============\n\n")**

**stop(tempo.cat)**

**}**

**if(length(name1) != length(name2)){**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ":\nLENGTH OF name1 ARGUMENT (", length(name1), ") IS NOT THE SAME AS LENGTH OF name2 ARGUMENT (", length(name2), "):\n", paste(name1, collapse = " "), "\n", paste(name2, collapse = " "), "\n\n============\n\n")**

**stop(tempo.cat)**

**}**

*# end column existence*

*# end other argument checking*

*# main code*

*# definition of set1 and set2: common columns*

**set1 <- data1[, name1, drop = FALSE]** *# set1 will be the reference for merging, drop = FALSE to keep the 2D structure*

**if(any(apply(set1, 2, FUN = "%in%", "factor"))){**

**if(factor.as == "numeric"){**

**set1[, apply(set1, 2, FUN = "%in%", "factor")] <- as.numeric(set1[, apply(set1, 2, FUN = "%in%", "factor")])**

**}**

**}**

**set2 <- data2[, name2, drop = FALSE]** *# set2 will be the reference for merging, drop = FALSE to keep the 2D structure*

**if(any(apply(set2, 2, FUN = "%in%", "factor"))){**

**if(factor.as == "numeric"){**

**set2[, apply(set2, 2, FUN = "%in%", "factor")] <- as.numeric(set2[, apply(set2, 2, FUN = "%in%", "factor")])**

**}**

**}**

*# end definition of set1 and set2: common columns*

*# conversion as character to avoid floating point problems*

**options.ini <- options()$digits**

**options(digits = 22)**

**set1 <- as.matrix(set1)**

**set2 <- as.matrix(set2)**

**mode(set1) <- "character"**

**mode(set2) <- "character"**

**options(digits = options.ini)**

*# end conversion as character to avoid floating point problems*

*# recovering initial order of set1*

**ini.set1.order <- eval(parse(text = paste("order(", paste("set1[, ", 1:ncol(set1), "]", sep = "", collapse = ", "), ")")))**

**set1 <- set1[ini.set1.order, ]**

**ini.set2.order <- eval(parse(text = paste("order(", paste("set2[, ", 1:ncol(set2), "]", sep = "", collapse = ", "), ")")))**

**set2 <- set2[ini.set2.order, ]**

*# end recovering initial order of set1*

*# check non identical columns*

**if(length(name1) > 1){**

**for(i2 in 1:(length(name1) - 1)){**

**for(i3 in (i2 + 1):length(name1)){**

**if(identical(set1[, i2], set1[, i3])){**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ":\nCOLUMN ", i2, " OF data1 CORRESPONDING TO ELEMENT ", name1[i2], " OF name1 ARGUMENT IS IDENTICAL TO COLUMN ", i3, " OF data1 CORRESPONDING TO ELEMENT ", name1[i3], " OF name1 ARGUMENT\n\n============\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**}**

**if(length(name2) > 1){**

**for(i2 in 1:(length(name2) - 1)){**

**for(i3 in (i2 + 1):length(name2)){**

**if(identical(set2[, i2], set2[, i3])){**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ":\nCOLUMN ", i2, " OF data2 CORRESPONDING TO ELEMENT ", name2[i2], " OF name2 ARGUMENT IS IDENTICAL TO COLUMN ", i3, " OF data2 CORRESPONDING TO ELEMENT ", name2[i3], " OF name2 ARGUMENT\n\n============\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**}**

*# end check non identical columns*

*# warning duplicates*

**# repositioning of the column in set2 as in set1 by comparing the two sorted column**

**#deal with identical col names when merging -> .x for data1, .y for data2**

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**# output <- list()**

**return(output)**

**}**

######## fun\_round() #### rounding number if decimal present

**# Check OK: clear to go Apollo**

**fun\_round <- function(data, dec.nb = 2, after.lead.zero = TRUE){**

*# AIM*

*# round a vector of values, if decimal, with the desired number of decimal digits after the decimal leading zeros*

*# WARNINGS*

*# Work well with numbers as character strings, but not always with numerical numbers because of the floating point*

*# Numeric values are really truncated from a part of their decimal digits, whatever options(digits) settings*

*# See ?.Machine or https://stackoverflow.com/questions/5173692/how-to-return-number-of-decimal-places-in-r, with the interexting formula: abs(x - round(x)) > .Machine$double.eps^0.5*

*# ARGUMENTS*

*# data: a vector of numbers (numeric or character mode)*

*# dec.nb: number of required decimal digits*

*# after.lead.zero: logical. If FALSE, rounding is performed for all the decimal numbers, whatever the leading zeros (e.g., 0.123 -> 0.12 and 0.00128 -> 0.00). If TRUE, dec.nb are taken after the leading zeros (e.g., 0.123 -> 0.12 and 0.00128 -> 0.0013)*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# RETURN*

*# the modified vector*

*# EXAMPLES*

*# ini.options <- options()$digits ; options(digits = 8) ; cat(fun\_round(data = c(NA, 10, 100.001, 333.0001254, 12312.1235), dec.nb = 2, after.lead.zero = FALSE), "\n\n") ; options(digits = ini.options)*

*# ini.options <- options()$digits ; options(digits = 8) ; cat(fun\_round(data = c(NA, 10, 100.001, 333.0001254, 12312.1235), dec.nb = 2, after.lead.zero = TRUE), "\n\n") ; options(digits = ini.options)*

*# ini.options <- options()$digits ; options(digits = 8) ; cat(fun\_round(data = c(NA, "10", "100.001", "333.0001254", "12312.1235"), dec.nb = 2, after.lead.zero = FALSE), "\n\n") ; options(digits = ini.options)*

*# ini.options <- options()$digits ; options(digits = 8) ; cat(fun\_round(data = c(NA, "10", "100.001", "333.0001254", "12312.1235"), dec.nb = 2, after.lead.zero = TRUE), "\n\n") ; options(digits = ini.options)*

*# DEBUGGING*

*# data = data = c(10, 100.001, 333.0001254, 12312.1235) ; dec.nb = 2 ; after.lead.zero = FALSE # # for function debugging*

*# data = data = c("10", "100.001", "333.0001254", "12312.1235") ; dec.nb = 2 ; after.lead.zero = TRUE # # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if( ! (all(typeof(data) == "character") | all(typeof(data) == "double") | all(typeof(data) == "integer"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data ARGUMENT MUST BE A VECTOR OF NUMBERS (IN NUMERIC OR CHARACTER MODE)\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data, class = "vector", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dec.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = after.lead.zero, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**tempo <- grepl(x = data, pattern = "\\.")** *# detection of decimal numbers*

**ini.mode <- mode(data)**

**data <- as.character(data)** *# to really truncate decimal digits*

**for(i in 1:length(data)){** *# scan all the numbers of the vector*

**if(tempo[i] == TRUE){** *# means decimal number*

**if(after.lead.zero == TRUE){**

**zero.pos <- unlist(gregexpr(text=data[i], pattern = 0))** *# recover all the position of the zeros in the number. -1 if no zeros (do not record the leading and trailing zeros)*

**}else{**

**zero.pos <- -1** *# -1 as if no zero*

**}**

**dot.pos <- unlist(gregexpr(text=data[i], pattern = "\\."))** *# recover all the position of the zeros in the number*

**digit.pos <- unlist(gregexpr(text=data[i], pattern = "[[:digit:]]"))** *# recover all the position of the digits in the number*

**dec.pos <- digit.pos[digit.pos > dot.pos]**

**count <- 0**

**while((dot.pos + count + 1) %in% zero.pos & (dot.pos + count + 1) <= max(dec.pos) & (count + dec.nb) < length(dec.pos)){** *# count the number of leading zeros in the decimal part*

**count <- count + 1**

**}**

**data[i] <- formatC(as.numeric(data[i]), digits = (count + dec.nb), format = "f")**

**}**

**}**

**if(ini.mode != "character"){**

**data <- as.numeric(data)**

**}**

**return(data)**

**}**

######## fun\_mat\_rotate() #### 90° clockwise matrix rotation

**# Check OK: clear to go Apollo**

**fun\_mat\_rotate <- function(data){**

*# AIM*

*# 90° clockwise matrix rotation*

*# applied twice, the function provide the mirror matrix, according to vertical and horizontal symmetry*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data: matrix (matrix class)*

*# RETURN*

*# the modified matrix*

*# EXAMPLES*

*# obs <- matrix(1:10, ncol = 1) ; obs ; fun\_mat\_rotate(obs)*

*# obs <- matrix(LETTERS[1:10], ncol = 5) ; obs ; fun\_mat\_rotate(obs)*

*# DEBUGGING*

*# data = matrix(1:10, ncol = 1)*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data, class = "matrix", fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**for (i in 1:ncol(data)){data[,i] <- rev(data[,i])}**

**data <- t(data)**

**return(data)**

**}**

######## fun\_mat\_num2color() #### convert a numeric matrix into hexadecimal color matrix

**# Check OK: clear to go Apollo**

**fun\_mat\_num2color <- function(mat1, mat.hsv.h = TRUE, notch = 1, s = 1, v = 1, forced.color = NULL){**

*# AIM*

*# convert a matrix made of numbers into a hexadecimal matrix for rgb colorization*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS:*

*# mat1: matrix 1 of non negative numerical values that has to be colored (matrix class). NA allowed*

*# mat.hsv.h: logical. Is mat1 the h of hsv colors ? (if TRUE, mat1 must be between zero and 1)*

*# notch: single value between 0 and 1 to shift the successive colors on the hsv circle by + notch*

*# s: s argument of hsv(). Must be between 0 and 1*

*# v: v argument of hsv(). Must be between 0 and 1*

*# forced.color: Must be NULL or hexadecimal color code or name given by colors(). The first minimal values of mat1 will be these colors. All the color of mat1 can be forced using this argument*

*# RETURN*

*# a list containing:*

*# $mat1.name: name of mat1*

*# $colored.mat: colors of mat1 in hexa*

*# $problem: logical. Is any colors of forced.color overlap the colors designed by the function. NULL if forced.color = NULL*

*# $text.problem: text when overlapping colors. NULL if forced.color = NULL or problem == FALSE*

*# EXAMPLES*

*# mat1 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2) ; dimnames(mat1) <- list(LETTERS[1:4], letters[1:2]) ; fun\_mat\_num2color(mat1, mat.hsv.h = FALSE, notch = 1, s = 1, v = 1, forced.color = NULL)*

*# DEBUGGING*

*# mat1 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2) ; dimnames(mat1) <- list(LETTERS[1:4], letters[1:2]); mat.hsv.h = FALSE ; notch = 1 ; s = 1 ; v = 1 ; forced.color = c(hsv(1,1,1), hsv(0,0,0)) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = mat1, mode = "numeric", class = "matrix", na.contain = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = mat.hsv.h, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = notch, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = s, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = v, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# argument checking without fun\_check()*

**if(mat.hsv.h == TRUE & fun\_check(data = mat1, mode = "numeric", prop = TRUE, print = FALSE)$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat1 ARGUMENT MUST BE A MATRIX OF PROPORTIONS SINCE THE mat.hsv.h ARGUMENT IS SET TO TRUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(forced.color)){**

**tempo <- fun\_check(data = forced.color, class = "character")**

**if(tempo$problem == TRUE){**

**stop()**

**}**

**if( ! all(forced.color %in% colors() | grepl(pattern = "^#", forced.color))){** *# check that all strings of forced.color start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": forced.color ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors()\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# end argument checking without fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**problem <- NULL**

**text.problem <- NULL**

**mat1.name <- deparse(substitute(mat1))**

*# change the scale of the plotted matrix*

**if(mat.hsv.h == TRUE){**

**if(any(min(mat1, na.rm = TRUE) < 0 | max(mat1, na.rm = TRUE) > 1, na.rm = TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat1 MUST BE MADE OF VALUES BETWEEN 0 AND 1 BECAUSE mat.hsv.h ARGUMENT SET TO TRUE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}else{**

**if(any(mat1 - floor(mat1) > 0, na.rm = TRUE) | any(mat1 == 0, na.rm = TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat1 MUST BE MADE OF INTEGER VALUES WITHOUT 0 BECAUSE mat.hsv.h ARGUMENT SET TO FALSE\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**mat1 <- mat1 / max(mat1, na.rm = TRUE)**

**}**

**}**

**if(notch != 1){**

**different.color <- unique(as.vector(mat1))**

**different.color <- different.color[ ! is.na(different.color)]**

**tempo.different.color <- different.color + c(0, cumsum(rep(notch, length(different.color) - 1)))**

**tempo.different.color <- tempo.different.color - floor(tempo.different.color)**

**if(any(duplicated(tempo.different.color) == TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DUPLICATED VALUES AFTER USING notch (", paste(tempo.different.color[duplicated(tempo.different.color)], collapse = " "), "). TRY ANOTHER notch VALUE\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(length(different.color) != length(tempo.different.color)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": LENGTH OF different.color (", paste(different.color, collapse = " "), ") DIFFERENT FROM LENGTH OF tempo.different.color (", paste(tempo.different.color, collapse = " "), ")\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**for(i in 1:length(different.color)){**

**mat1[mat1 == different.color[i]] <- tempo.different.color[i]**

**}**

**}**

**}**

**if( ! is.null(forced.color)){**

**hexa.values.to.change <- hsv(unique(sort(mat1))[1:length(forced.color)], s, v)**

**}**

**mat1[ ! is.na(mat1)] <- hsv(mat1[ ! is.na(mat1)], s, v)**

**if( ! is.null(forced.color)){**

**if(any(forced.color %in% mat1, na.rm = TRUE)){**

**problem <- TRUE**

**text.problem <- paste0("THE FOLLOWING COLORS WHERE INTRODUCED USING forced.color BUT WHERE ALREADY PRESENT IN THE COLORED MATRIX :", paste(forced.color[forced.color %in% mat1], collapse = " "))**

**}else{**

**problem <- FALSE**

**}**

**for(i in 1:length(hexa.values.to.change)){**

**if( ! any(mat1 == hexa.values.to.change[i], na.rm = TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE ", hexa.values.to.change[i], " VALUE FROM hexa.values.to.change IS NOT REPRESENTED IN mat1 : ", paste(unique(as.vector(mat1)), collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**mat1[which(mat1 == hexa.values.to.change[i])] <- forced.color[i]**

**}**

**}**

**}**

**output <- list(mat1.name = mat1.name, colored.mat = mat1, problem = problem, text.problem = text.problem)**

**return(output)**

**}**

######## fun\_mat\_op() #### assemble several matrices with operation

**# Check OK: clear to go Apollo**

**fun\_mat\_op <- function(mat.list, kind.of.operation = "+"){**

*# AIM*

*# assemble several matrices of same dimensions by performing by case operation. For instance add the value of all the case 1 (row1 & column1) of the matrices and put it in the case 1 of a new matrix M, add the value of all the case 2 (row2 & column1) of the matrices and put it in the case 2 of a new matrix M, etc.*



*# c: case*

*# i: row number*

*# j: column number*

*# k: matrix number*

*# z: number of matrices*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_2d\_comp()*

*# ARGUMENTS:*

*# mat.list: list of matrices*

*# kind.of.operation: either "+" (by case addition), "-" (by case subtraction) or "\*" (by case multiplication)*

*# RETURN*

*# the assembled matrix, with row and/or column names only if all the matrices have identical row/column names*

*# EXAMPLES*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2) ; fun\_mat\_op(mat.list = list(mat1, mat2), kind.of.operation = "+")*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; fun\_mat\_op(mat.list = list(mat1, mat2), kind.of.operation = "\*")*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2, dimnames = list(LETTERS[1:4], c(NA, NA))) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; fun\_mat\_op(mat.list = list(mat1, mat2), kind.of.operation = "-")*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2, dimnames = list(c("A1", "A2", "A3", "A4"), letters[1:2])) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; mat3 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; fun\_mat\_op(mat.list = list(mat1, mat2, mat3), kind.of.operation = "+")*

*# DEBUGGING*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2) ; mat.list = list(mat1, mat2) ; kind.of.operation = "+" # for function debugging*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8), ncol = 2, dimnames = list(LETTERS[1:4], c(NA, NA))) ; mat2 = matrix(c(1,1,1,2,1,5,9,NA), ncol = 2, dimnames = list(LETTERS[1:4], letters[1:2])) ; mat.list = list(mat1, mat2) ; kind.of.operation = "\*" # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_2d\_comp() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = mat.list, class = "list", fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = kind.of.operation, options = c("+", "-", "\*"), length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# argument checking without fun\_check()*

**if(length(mat.list) < 2){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat.list ARGUMENT MUST BE A LIST CONTAINING AT LEAST 2 MATRICES\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**for(i0 in 1:length(mat.list)){**

**tempo <- fun\_check(data = mat.list[[i0]], class = "matrix", mode = "numeric", na.contain = TRUE)**

**if(tempo$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ELEMENT ", i0, " OF mat.list ARGUMENT MUST BE A NUMERIC MATRIX\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**ident.row.names <- TRUE**

**ident.col.names <- TRUE**

**for(i0 in 2:length(mat.list)){**

**tempo <- fun\_2d\_comp(data1 = mat.list[[1]], data2 = mat.list[[i0]])**

**if(tempo$same.dim == FALSE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": MATRIX ", i0, " OF mat.list ARGUMENT MUST HAVE THE SAME DIMENSION (", paste(dim(mat.list[[i0]]), collapse = " "), ") THAN THE MATRIX 1 IN mat.list (", paste(dim(mat.list[[1]]), collapse = " "), ")\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(tempo$same.row.name)){**

**if(tempo$same.row.name != TRUE){** *# != TRUE to deal with NA*

**ident.row.names <- FALSE**

**}**

**}**

**if( ! is.null(tempo$same.col.name)){**

**if(tempo$same.col.name != TRUE){** *# != TRUE to deal with NA*

**ident.col.names <- FALSE**

**}**

**}**

**}**

*# end argument checking without fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**output <- mat.list[[1]]**

**for(i0 in 2:length(mat.list)){**

**output <- get(kind.of.operation)(output, mat.list[[i0]])**

**}**

**dimnames(output) <- NULL**

**if(ident.row.names == TRUE){**

**rownames(output) <- rownames(mat.list[[1]])**

**}**

**if(ident.col.names == TRUE){**

**colnames(output) <- colnames(mat.list[[1]])**

**}**

**return(output)**

**}**

######## fun\_mat\_inv() #### return the inverse of a square matrix

**# Check OK: clear to go Apollo**

**fun\_mat\_inv <- function(mat){**

*# AIM*

*# return the inverse of a square matrix when solve() cannot*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS:*

*# mat: a square numeric matrix without NULL, NA, Inf or single case (dimension 1, 1) of 0*

*# RETURN*

*# the inversed matrix*

*# EXAMPLES*

*# mat1 = matrix(c(1,1,1,2,1,5,9,8,9), ncol = 3) ; fun\_mat\_inv(mat = mat1) # use solve()*

*# mat1 = matrix(c(0,0,0,0,0,0,0,0,0), ncol = 3) ; fun\_mat\_inv(mat = mat1) # use the trick*

*# mat1 = matrix(c(1,1,1,2,Inf,5,9,8,9), ncol = 3) ; fun\_mat\_inv(mat = mat1)*

*# mat1 = matrix(c(1,1,1,2,NA,5,9,8,9), ncol = 3) ; fun\_mat\_inv(mat = mat1)*

*# mat1 = matrix(c(1,2), ncol = 1) ; fun\_mat\_inv(mat = mat1)*

*# mat1 = matrix(0, ncol = 1) ; fun\_mat\_inv(mat = mat1)*

*# mat1 = matrix(2, ncol = 1) ; fun\_mat\_inv(mat = mat1)*

*# DEBUGGING*

*# mat = matrix(c(1,1,1,2,1,5,9,8,9), ncol = 3) # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = mat, class = "matrix", mode = "numeric", fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# argument checking without fun\_check()*

**if(ncol(mat) != nrow(mat)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT MUST BE A SQUARE MATRIX\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(any(mat %in% c(Inf, -Inf, NA))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT MUST BE A MATRIX WITHOUT Inf, -Inf OR NA\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(all(mat == 0) & ncol(mat) == 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT CANNOT BE A SQUARE MATRIX MADE OF A SINGLE CASE OF 0\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**if(any(grepl(x = try(solve(mat), silent = TRUE)[], pattern = "[Ee]rror"))){**

**tempo <- svd(mat)**

**val.critique <- which(tempo$d < 10^-8)**

**Diag.mod <- diag(1 / tempo$d)**

**for(i in val.critique){**

**Diag.mod[i, i] <- 0**

**}**

**return(tempo$v %\*% Diag.mod %\*% t(tempo$u))**

**}else{**

**return(solve(mat))**

**}**

**}**

######## fun\_mat\_fill() #### fill the empty half part of a symmetric square matrix

**# Check OK: clear to go Apollo**

**fun\_mat\_fill <- function(mat, empty.cell.string = 0, warn.print = FALSE){**

*# AIM*

*# detect the empty half part of a symmetric square matrix (either topleft, topright, bottomleft or bottomright)*

*# fill this empty half part using the other symmetric half part of the matrix*

*# WARNINGS*

*# a plot verification using fun\_gg\_heatmap() is recommanded*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS:*

*# mat: a numeric or character square matrix with the half part (according to the grand diagonal) filled with NA (any kind of matrix), "0" (character matrix) or 0 (numeric matrix) exclusively (not a mix of 0 and NA in the empty part)*

*# empty.cell.string: a numeric, character or NA (no quotes) indicating what empty cells are filled with*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# RETURN*

*# a list containing:*

*# $mat: the filled matrix*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# mat1 = matrix(c(1,NA,NA,NA, 0,2,NA,NA, NA,3,4,NA, 5,6,7,8), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = NA, warn.print = TRUE) # bottomleft example*

*# mat1 = matrix(c(1,1,1,2, 0,2,3,0, NA,3,0,0, 5,0,0,0), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = NA, warn.print = TRUE) # error example*

*# mat1 = matrix(c(1,1,1,2, 0,2,3,0, NA,3,0,0, 5,0,0,0), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = 0, warn.print = TRUE) # bottomright example*

*# mat1 = matrix(c(1,1,1,2, "a",2,3,NA, "a","a",0,0, "a","a","a",0), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = "a", warn.print = TRUE) # topright example*

*# mat1 = matrix(c(0,0,0,2, 0,0,3,0, 0,3,0,NA, 5,0,0,0), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = 0, warn.print = TRUE) # topleft example*

*# mat1 = matrix(c(0,0,0,2, 0,0,3,0, 0,3,0,0, 5,0,0,0), ncol = 4) ; mat1 ; fun\_mat\_fill(mat = mat1, empty.cell.string = 0, warn.print = TRUE) # error example*

*# DEBUGGING*

*# mat = matrix(c(1,NA,NA,NA, 0,2,NA,NA, NA,3,4,NA, 5,6,7,8), ncol = 4) ; empty.cell.string = NA ; warn.print = TRUE # for function debugging*

*# mat = matrix(c(0,0,0,2, 0,0,3,0, 0,3,0,NA, 5,0,0,0), ncol = 4) ; empty.cell.string = 0 ; warn.print = TRUE # for function debugging # topleft example*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = mat, class = "matrix", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = empty.cell.string, class = "vector", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# argument checking without fun\_check()*

**if(ncol(mat) != nrow(mat)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT MUST BE A SQUARE MATRIX\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (mode(mat) %in% c("numeric", "character"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT MUST BE A NUMERIC OR CHARACTER MATRIX\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(nrow(mat) == 1 & ncol(mat) == 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT CANNOT BE A SQUARE MATRIX MADE OF A SINGLE CASE\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(ifelse(is.na(empty.cell.string), ! any(is.na(mat)), ! any(mat == empty.cell.string, na.rm = TRUE))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mat ARGUMENT MATRIX MUST HAVE CELLS WITH THE EMPTY STRING SPECIFIED IN empty.cell.string ARGUMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**list.diag <- vector("list", length = nrow(mat) - 1)**

**for(i0 in 1:(nrow(mat) - 1)){**

**list.diag[[i0]] <- numeric(length = nrow(mat) - i0)**

**}**

**sector <- c("topleft", "topright", "bottomright", "bottomleft")**

**diag.scan <-c(** *# same order as sector. Recover each diag from center to corner*

**"mat[as.matrix(as.data.frame(list(1:(nrow(mat) - i1), (ncol(mat) -i1):1)))]",** *# topleft part*

**"mat[as.matrix(as.data.frame(list(1:(nrow(mat) - i1), (1:ncol(mat))[-(1:i1)])))]",** *# topright part*

**"mat[as.matrix(as.data.frame(list((1 + i1):nrow(mat), ncol(mat):(1 + i1))))]",** *# bottomright part*

**"mat[as.matrix(as.data.frame(list((1 + i1):nrow(mat), 1:(ncol(mat) -i1))))]"** *# bottomleft part*

**)**

*# empty part detection*

**tempo.list.diag <- list.diag**

**empty.sector <- NULL**

**full.sector <- NULL**

**warning <- NULL**

**for(i0 in 1:length(sector)){**

**tempo.list.diag <- list.diag**

**for(i1 in 1:(nrow(mat) - 1)){**

**tempo.list.diag[[i1]] <- eval(parse(text = diag.scan[i0]))**

**if(ifelse(is.na(empty.cell.string), ! all(is.na(tempo.list.diag[[i1]])), ! (all(tempo.list.diag[[i1]] == empty.cell.string, na.rm = TRUE) & ! (is.na(all(tempo.list.diag[[i1]] == empty.cell.string, na.rm = FALSE)))))){** *# I had to add this ! (is.na(all(tempo.list.diag[[i1]] == empty.cell.string, na.rm = FALSE))) because all(tempo.list.diag[[i1]] == empty.cell.string, na.rm = FALSE) gives NA and not FALSE if one NA in tempo.list.diag[[i1]] -> not good for if()*

**full.sector <- c(full.sector, sector[i0])**

**break**

**}**

**}**

**if(i1 == nrow(mat) - 1){**

**if(all(unlist(lapply(tempo.list.diag, FUN = function(x){if(is.na(empty.cell.string)){is.na(x)}else{x == empty.cell.string}})), na.rm = TRUE)){**

**empty.sector <- c(empty.sector, sector[i0])**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": EMPTY SECTOR DETECTED ON THE ", toupper(sector[i0]), " CORNER, FULL OF ", empty.cell.string)**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE ", toupper(sector[i0]), " SECTOR, DETECTED AS EMPTY, IS NOT? DIFFERENT VALUES IN THIS SECTOR:\n", paste(names(table(unlist(tempo.list.diag), useNA = "ifany")), collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

*# end empty part detection*

**if(length(empty.sector) == 0){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ACCORDING TO empty.cell.string ARGUMENT (", empty.cell.string, "), mat ARGUMENT MATRIX HAS ZERO EMPTY HALF PART")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**if(length(empty.sector) > 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ACCORDING TO empty.cell.string ARGUMENT (", empty.cell.string, "), mat ARGUMENT MATRIX HAS MORE THAN ONE EMPTY HALF PART (ACCORDING TO THE GRAND DIAGONAL): ", paste(empty.sector, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(any(full.sector %in% empty.sector, na.rm = TRUE)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE FUNCTION HAS DETECTED EMPTY AND NON EMPTY HALF PART IN THE SAME SECTOR: ", paste(full.sector[full.sector %in% empty.sector], collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(length(empty.sector) + length(full.sector)!= 4){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE FUNCTION HAS DETECTED MORE OR LESS SECTORS THAN 4:\nEMPTY SECTORS:", paste(empty.sector, collapse = " "), "\nFULL SECTORS:", paste(full.sector, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# matrix filling*

**for(i1 in 1:(nrow(mat) - 1)){**

**if(empty.sector == "topleft"){**

**eval(parse(text = paste0(diag.scan[1], " <- ", diag.scan[3])))**

**}else if(empty.sector == "topright"){**

**eval(parse(text = paste0(diag.scan[2], " <- ", diag.scan[4])))**

**}else if(empty.sector == "bottomright"){**

**eval(parse(text = paste0(diag.scan[3], " <- ", diag.scan[1])))**

**}else if(empty.sector == "bottomleft"){**

**eval(parse(text = paste0(diag.scan[4], " <- ", diag.scan[2])))**

**}**

**}**

*# end matrix filling*

**}**

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**return(list(mat = mat, warnings = warning))**

**}**

######## fun\_permut() #### progressively breaks a vector order

**fun\_permut <- function(data1, data2 = NULL, n = NULL, seed = NULL, count.print = 10, text.print = "", cor.method = "spearman", cor.limit = 0.2, warn.print = FALSE, path.lib = NULL){**

*# AIM*

*# reorder the elements of the data1 vector by flipping 2 randomly selected consecutive positions either:*

*# 1) n times (when n is precised) or*

*# 2) until the correlation between data1 and data2 decreases down to the cor.limit (0.2 by default). See cor.limit below to deal with negative correlations*

*# Example of consecutive position flipping: ABCD -> BACD -> BADC, etc.*

*# WARNINGS*

*# see # https://www.r-bloggers.com/strategies-to-speedup-r-code/ for code speedup*

*# the random switch of non consecutive positions (ABCD -> DBCA for instance) does not work very well as the correaltion is quickly obtained but the initial vector structure is mainly kept (no much order). Ths code would be: pos <- ini.pos[1:2] ; pos <- sample.int(n = n , size = 2, replace = FALSE) ; tempo.pos[pos] <- tempo.pos[rev(pos)]*

*# ARGUMENTS*

*# data1: a vector of at least 2 elements. Must be numeric if data2 is specified*

*# data2: a numeric vector of same length as data1*

*# n: number of times "flipping 2 randomly selected consecutive positions". Ignored if data2 is specified*

*# seed: integer number used by set.seed(). Write NULL if random result is required, an integer otherwise. BEWARE: if not NULL, fun\_permut() will systematically return the same result when the other parameters keep the same settings*

*# count.print: interger value. Print a working progress message every count.print during loops. BEWARE: can increase substentially the time to complete the process using a small value, like 10 for instance. Use Inf is no loop message desired*

*# text.print: optional message to add to the working progress message every count.print loop*

*# cor.method: correlation method. Either "pearson", "kendall" or "spearman". Ignored if data2 is not specified*

*# cor.limit: a correlation limit (between 0 and 1). Ignored if data2 is not specified. Compute the correlation between data1 and data2, permute the data1 values, and stop the permutation process when the correlation between data1 and data2 decreases down below the cor limit value (0.2 by default). If cor(data1, data2) is negative, then -cor.limit is used and the process stops until the correlation between data1 and data2 increases up over cor.limit (-0.2 by default). BEWARE: write a positive cor.limit even if cor(data1, data2) is known to be negative. The function will automatically uses -cor.limit. If the initial correlation is already below cor.limit (positive correlation) or over -cor.limit (negative correlation), then the data1 value positions are completely randomized (correlation between data1 and data2 is expected to be 0)*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# lubridate*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# fun\_round()*

*# RETURN*

*# a list containing:*

*# $data: the modified vector*

*# $warnings: potential warning messages (in case of negative correlation when data2 is specified). NULL if non warning message*

*# $cor: a spearman correlation between the initial positions (1:length(data1) and the final positions if data2 is not specified and the final correlation between data1 and data2 otherwise, according to cor.method*

*# $count: the number of loops used*

*# EXAMPLES*

*# example (1) showing that for loop, used in fun\_permut(), is faster than while loop*

*# ini.time <- as.numeric(Sys.time()) ; count <- 0 ; for(i0 in 1:1e9){count <- count + 1} ; tempo.time <- as.numeric(Sys.time()) ; tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - ini.time)) ; tempo.lapse*

*# example (2) showing that for loop, used in fun\_permut(), is faster than while loop*

*# ini.time <- as.numeric(Sys.time()) ; count <- 0 ; while(count < 1e9){count <- count + 1} ; tempo.time <- as.numeric(Sys.time()) ; tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - ini.time)) ; tempo.lapse*

*# fun\_permut(data1 = LETTERS[1:5], data2 = NULL, n = 100, seed = 1, count.print = 10, text.print = "CPU NB 4")*

*# fun\_permut(data1 = 101:110, data2 = 21:30, seed = 1, count.print = 1e4, text.print = "", cor.method = "spearman", cor.limit = 0.2)*

*# a way to use the cor.limit argument just considering data1*

*# obs1 <- 101:110 ; fun\_permut(data1 = obs1, data2 = obs1, seed = 1, count.print = 10, cor.method = "spearman", cor.limit = 0.2)*

*# fun\_permut(data1 = 1:1e3, data2 = 1e3:1, seed = 1, count.print = 1e6, text.print = "", cor.method = "spearman", cor.limit = 0.7)*

*# fun\_permut(data1 = 1:1e2, data2 = 1e2:1, seed = 1, count.print = 1e3, cor.limit = 0.5)*

*# fun\_permut(data1 = c(0,0,0,0,0), n = 5, data2 = NULL, seed = 1, count.print = 1e3, cor.limit = 0.5)*

*# DEBUGGING*

*# data1 = LETTERS[1:5] ; data2 = NULL ; n = 1e6 ; seed = NULL ; count.print = 1e3 ; text.print = "" ; cor.method = "spearman" ; cor.limit = 0.2 ; warn.print = TRUE ; path.lib = NULL*

*# data1 = LETTERS[1:5] ; data2 = NULL ; n = 10 ; seed = 22 ; count.print = 10 ; text.print = "" ; cor.method = "spearman" ; cor.limit = 0.2 ; warn.print = TRUE ; path.lib = NULL*

*# data1 = 101:110 ; data2 = 21:30 ; n = 10 ; seed = 22 ; count.print = 10 ; text.print = "" ; cor.method = "spearman" ; cor.limit = 0.2 ; warn.print = TRUE ; path.lib = NULL*

*# data1 = 1:1e3 ; data2 = 1e3:1 ; n = 20 ; seed = 22 ; count.print = 1e6 ; text.print = "" ; cor.method = "spearman" ; cor.limit = 0.5 ; warn.print = TRUE ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_round", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data1, class = "vector", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & length(data1) < 2){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data1 ARGUMENT MUST BE A VECTOR OF MINIMUM LENGTH 2. HERE IT IS: ", length(data1),"\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(data2)){**

**tempo <- fun\_check(data = data1, class = "vector", mode = "numeric", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data1 MUST BE A NUMERIC VECTOR IF data2 ARGUMENT IS SPECIFIED\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = data2, class = "vector", mode = "numeric", fun.name = function.name) ; eval(ee)**

**if(length(data1) != length(data2)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data1 AND data2 MUST BE VECTOR OF SAME LENGTH. HERE IT IS ", length(data1)," AND ", length(data2), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}else if(is.null(n)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": n ARGUMENT CANNOT BE NULL IF data2 ARGUMENT IS NULL\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(n)){**

**tempo <- fun\_check(data = n, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(seed)){**

**tempo <- fun\_check(data = seed, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = count.print, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = text.print, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = cor.method, options = c("pearson", "kendall", "spearman"), length =1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = cor.limit, class = "vector", mode = "numeric", prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**tempo.cat <- paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = "lubridate", path.lib = path.lib)**

*# end package checking*

*# main code*

*# code that protects set.seed() in the global environment*

*# see also Protocol 100-rev0 Parallelization in R.docx*

**if(exists(".Random.seed", envir = .GlobalEnv)){** *# if .Random.seed does not exists, it means that no random operation has been performed yet in any R environment*

**tempo.random.seed <- .Random.seed**

**on.exit(assign(".Random.seed", tempo.random.seed, env = .GlobalEnv))**

**}else{**

**on.exit(set.seed(NULL))** *# inactivate seeding -> return to complete randomness*

**}**

*# end code that protects set.seed() in the global environment*

**if( ! is.null(seed)){**

**set.seed(seed)**

**}**

**ini.date <- Sys.time()** *# time of process begin, converted into seconds*

**ini.time <- as.numeric(ini.date)** *# time of process begin, converted into seconds*

**ini.pos <- 1:length(data1)** *# positions of data1 before permutation loops*

**tempo.pos <- ini.pos** *# positions of data1 that will be modified during loops*

**# pos.selec.seq <- ini.pos[-length(data1)]** *# selection of 1 position in initial position, without the last because always up permutation (pos -> pos+1 & pos+1 -> pos)*

**pos.selec.seq.max <- length(ini.pos) - 1** *# max position (used by sample.int() function). See below for - 1*

**warnings <- NULL**

**count <- 0**

**round <- 0**

**BREAK <- FALSE**

**tempo.cor <- 0**

**if(is.null(data2)){**

**if(length(table(data1)) == 1){**

**tempo.warnings <- paste0("NO PERMUTATION PERFORMED BECAUSE data1 ARGUMENT SEEMS TO BE MADE OF IDENTICAL ELEMENTS: ", names(table(data1)))**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)** *#*

**}else{**

**if(count.print > n){**

**count.print <- n**

**}**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FOR LOOP OF ", n, " LOOPS INITIATED | LOOP COUNT: ", format(count, big.mark=",")))**

**count.print.loop <- logical(length = count.print)**

**count.print.loop[length(count.print.loop)] <- TRUE** *# not this to avoid long vector, but not forget to reset during printing: count.print.loop[(1:trunc(n / count.print) \* count.print)] <- TRUE # counter to speedup*

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# selection of random positions. BEWARE: n = pos.selec.seq.max because already - 1 (see above) but is connected to tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]*

**tempo.date.loop <- Sys.time()**

**tempo.time.loop <- as.numeric(tempo.date.loop)**

**for(i3 in 1:n){**

**count.loop <- count.loop + 1**

**pos2 <- pos[count.loop]** *# selection of 1 position*

**tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]**

**if(count.print.loop[count.loop]){**

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# BEWARE: never forget to resample here*

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - tempo.time.loop))**

**final.loop <- (tempo.time - tempo.time.loop) / i3 \* n**

**final.exp <- as.POSIXct(final.loop, origin = tempo.date.loop)**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FOR LOOP ", i3, " / ", n, " | TIME SPENT: ", tempo.lapse, " | EXPECTED END: ", final.exp))**

**}**

**}**

**count <- count + n** *# out of the loop to speedup*

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FOR LOOP ENDED | LOOP COUNT: ", format(count, big.mark=",")))**

**cat("\n\n")**

**}**

**}else{**

**if(length(table(data1)) == 1){**

**tempo.warnings <- paste0("NO PERMUTATION PERFORMED BECAUSE data1 ARGUMENT SEEMS TO BE MADE OF IDENTICAL ELEMENTS: ", names(table(data1)))**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)** *#*

**tempo.cor <- 1**

**}else if(length(table(data2)) == 1){**

**tempo.warnings <- paste0("NO PERMUTATION PERFORMED BECAUSE data2 ARGUMENT SEEMS TO BE MADE OF IDENTICAL ELEMENTS: ", names(table(data2)))**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)** *#*

**tempo.cor <- 1**

**}else{**

**cor.ini <- cor(x = data1, y = data2, use = "pairwise.complete.obs", method = cor.method)**

**tempo.cor <- cor.ini** *# correlation that will be modified during loops*

**neg.cor <- FALSE**

**if(tempo.cor < 0){**

**tempo.warnings <- paste0("INITIAL ", toupper(cor.method), " CORRELATION BETWEEN data1 AND data2 HAS BEEN DETECTED AS NEGATIVE: ", tempo.cor, ". THE LOOP STEPS WILL BE PERFORMED USING POSITIVE CORRELATIONS BUT THE FINAL CORRELATION WILL BE NEGATIVE")**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)** *#*

**neg.cor <- TRUE**

**tempo.cor <- abs(tempo.cor)**

**cor.ini <- abs(cor.ini)**

**}**

**if(tempo.cor < cor.limit){** *# randomize directly all the position to be close to correlation zero*

**tempo.warnings <- paste0("INITIAL ABSOLUTE VALUE OF THE ", toupper(cor.method), " CORRELATION ", fun\_round(tempo.cor), " BETWEEN data1 AND data2 HAS BEEN DETECTED AS BELOW THE CORRELATION LIMIT PARAMETER ", cor.limit, "\nTHE data1 SEQUENCE HAS BEEN COMPLETELY RANDOMIZED TO CORRESPOND TO CORRELATION ZERO")**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)** *#*

**for(i4 in 1:5){** *# done 5 times to be sure of the complete randomness*

**tempo.pos <- sample(x = tempo.pos, size = length(tempo.pos), replace = FALSE)**

**}**

**count <- count + 5** *# out of the loop to speedup*

**}else{**

*# smallest correlation decrease*

**count <- count + 1** *# 1 and not 0 because already 1 performed just below*

**pos <- sample.int(n = pos.selec.seq.max , size = 1, replace = TRUE)** *# selection of 1 position # pos.selec.seq.max because selection of 1 position in initial position, without the last because always up permutation (pos -> pos+1 & pos+1 -> pos)*

**tempo.pos[c(pos + 1, pos)] <- tempo.pos[c(pos, pos + 1)]**

**tempo.cor <- abs(cor(x = data1[tempo.pos], y = data2, use = "pairwise.complete.obs", method = cor.method))**

**smallest.cor.dec <- cor.ini - tempo.cor**

*# end smallest correlation decrease*

*# going out of tempo.cor == cor.ini*

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "CORRELATION DECREASE AFTER A SINGLE PERMUTATION: ", fun\_round(smallest.cor.dec, 4)))**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FIRST WHILE LOOP STEP -> GOING OUT FROM EQUALITY | LOOP COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4)))**

**count.print.loop <- logical(length = count.print)**

**count.print.loop[length(count.print.loop)] <- TRUE** *# counter to speedup*

**count.loop <- 0** *#*

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# selection of random positions. BEWARE: n = pos.selec.seq.max because already - 1 (see above) but is connected to tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]*

**tempo.date.loop <- Sys.time()**

**tempo.time.loop <- as.numeric(tempo.date.loop)**

**while(tempo.cor == cor.ini){** *# to be out of equality between tempo.cor and cor.ini at the beginning (only valid for very long vector)*

**count <- count + 1**

**count.loop <- count.loop + 1**

**pos2 <- pos[count.loop]**

**tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]**

**tempo.cor <- abs(cor(x = data1[tempo.pos], y = data2, use = "pairwise.complete.obs", method = cor.method))**

**if(count.print.loop[count.loop]){**

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# BEWARE: never forget to resample here*

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - tempo.time.loop))**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FIRST WHILE LOOP STEP", format(count.loop, big.mark=","), " / ? | COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4), " | TIME SPENT: ", tempo.lapse))**

**}**

**}**

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - ini.time))**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FIRST WHILE LOOP STEP END | LOOP COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4), " | TOTAL SPENT TIME: ", tempo.lapse))**

**if(tempo.cor < cor.limit){**

**tempo.warnings <- paste0("THE FIRST FOR & WHILE LOOP STEPS HAVE BEEN TOO FAR AND SUBSEQUENT LOOP STEPS WILL NOT RUN")**

**warnings <- paste0(warnings, ifelse(is.null(warnings), "", "\n"), tempo.warnings)**

**}**

*# end going out of tempo.cor == cor.ini*

*# estimation of the average correlation decrease per loop on x loops and for loop execution*

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "WHILE/FOR LOOPS INITIATION | LOOP COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4)))**

**count.est <- 1e5**

**first.round <- TRUE**

**GOBACK <- FALSE**

**while(tempo.cor > cor.limit){**

**round <- round + 1**

*# estimation step*

**if(first.round == TRUE){**

**first.round <- FALSE**

**cor.dec.per.loop <- numeric(length = 5)**

**loop.nb.est <- Inf**

**cor.est.ini <- tempo.cor**

**cor.est <- numeric(length = 5)**

**for(i6 in 1:5){** *# connected to cor.dec.per.loop*

**tempo.pos.est <- tempo.pos**

**pos <- sample.int(n = pos.selec.seq.max , size = count.est, replace = TRUE)** *# selection of n position*

**for(i7 in 1:count.est){**

**pos2 <- pos[i7]** *# selection of 1 position*

**tempo.pos.est[c(pos2 + 1, pos2)] <- tempo.pos.est[c(pos2, pos2 + 1)]**

**}**

**tempo.cor.est <- abs(cor(x = data1[tempo.pos.est], y = data2, use = "pairwise.complete.obs", method = cor.method))**

**cor.est[i6] <- tempo.cor.est**

**tempo.cor.dec.per.loop <- (cor.est.ini - tempo.cor.est) / count.est** *# correlation decrease per loop*

**if(is.na(tempo.cor.dec.per.loop) | ! is.finite(tempo.cor.dec.per.loop)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\ncor.est.ini: ", cor.est.ini, "\ntempo.cor.est: ", tempo.cor.est, "\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**cor.dec.per.loop[i6] <- tempo.cor.dec.per.loop**

**}**

**cor.est <- cor.est[which.max(cor.dec.per.loop)]** *# max to avoid to go to far with for loop (tempo.cor below tempo.limit)*

**cor.dec.per.loop <- max(cor.dec.per.loop, na.rm = TRUE)** *# max to avoid to go to far with for loop (tempo.cor below tempo.limit)*

**loop.nb.est <- round((tempo.cor - cor.limit) / cor.dec.per.loop)**

**}else{**

**if(GOBACK == TRUE){**

**loop.nb.est <- round(loop.nb.est / 2)**

**}else{**

**cor.dec.per.loop <- (cor.ini - tempo.cor) / count**

**loop.nb.est <- round((tempo.cor - cor.limit) / cor.dec.per.loop)**

**}**

**}**

*# end estimation step*

*# loop step*

**if(is.na(loop.nb.est) | ! is.finite(loop.nb.est)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 1\nloop.nb.est: ", loop.nb.est, "\ncor.ini: ", cor.ini, "\ntempo.cor: ", tempo.cor, "\ncor.limit: ", cor.limit, "\ncor.dec.per.loop: ", cor.dec.per.loop, "\n\n============\n\n"))**

**stop(tempo.cat)**

**}else if(loop.nb.est > 1e4){** *# below -> leave the while loop*

**tempo.pos.secu <- tempo.pos**

**count.secu <- count**

**tempo.cor.secu <- tempo.cor**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "INITIAL SETTINGS BEFORE ROUND: ", round, " | LOOP COUNT: ", format(count, big.mark=","), " | GO BACK: ", GOBACK, " | LOOP NUMBER ESTIMATION: ", format(loop.nb.est, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4)))**

**count.print.loop <- logical(length = count.print)**

**count.print.loop[length(count.print.loop)] <- TRUE** *# not this to avoid long vector, but not forget to reset during printing: count.print.loop[(1:trunc(n / count.print) \* count.print)] <- TRUE # counter to speedup*

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# selection of random positions. BEWARE: n = pos.selec.seq.max because already - 1 (see above) but is connected to tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]*

**tempo.date.loop <- Sys.time()**

**tempo.time.loop <- as.numeric(tempo.date.loop)**

**for(i6 in 1:loop.nb.est){**

**count.loop <- count.loop + 1**

**pos2 <- pos[count.loop] # selection of 1 position**

**tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]**

**if(count.print.loop[count.loop]){**

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# BEWARE: never forget to resample here*

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - tempo.time.loop))**

**final.loop <- (tempo.time - tempo.time.loop) / i6 \* loop.nb.est** *# intra nb.compar loop lapse: time lapse / cycles done \* cycles remaining*

**final.exp <- as.POSIXct(final.loop, origin = tempo.date.loop)**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FOR LOOP | ROUND ", round, " | LOOP: ", format(i6, big.mark=","), " / ", format(loop.nb.est, big.mark=","), " | TIME SPENT: ", tempo.lapse, " | EXPECTED END: ", final.exp))**

**}**

**}**

**count <- count + loop.nb.est** *# out of the loop to speedup*

**tempo.cor <- abs(cor(x = data1[tempo.pos], y = data2, use = "pairwise.complete.obs", method = cor.method))**

**if(tempo.cor > tempo.cor.secu | ((tempo.cor - cor.limit) < 0 & abs(tempo.cor - cor.limit) > smallest.cor.dec \* round(log10(max(ini.pos, na.rm = TRUE))))){**

**GOBACK <- TRUE**

**tempo.pos <- tempo.pos.secu**

**count <- count.secu**

**tempo.cor <- tempo.cor.secu**

**}else{**

**GOBACK <- FALSE**

**}**

**}else{**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "FINAL WHILE LOOP | LOOP COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4)))**

**count.print.loop <- logical(length = count.print)**

**count.print.loop[length(count.print.loop)] <- TRUE** *# counter to speedup*

**count.loop <- 0 #**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# selection of random positions. BEWARE: n = pos.selec.seq.max because already - 1 (see above) but is connected to tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]*

**tempo.cor.loop <- tempo.cor**

**tempo.date.loop <- Sys.time()**

**tempo.time.loop <- as.numeric(tempo.date.loop)**

**while(tempo.cor > cor.limit){**

**count <- count + 1**

**count.loop <- count.loop + 1**

**pos2 <- pos[count.loop]**

**tempo.pos[c(pos2 + 1, pos2)] <- tempo.pos[c(pos2, pos2 + 1)]**

**tempo.cor <- abs(cor(x = data1[tempo.pos], y = data2, use = "pairwise.complete.obs", method = cor.method))**

**if(count.print.loop[count.loop]){**

**count.loop <- 0**

**pos <- sample.int(n = pos.selec.seq.max , size = count.print, replace = TRUE)** *# BEWARE: never forget to resample here*

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - tempo.time.loop))**

**final.loop <- (tempo.time - tempo.time.loop) / (tempo.cor.loop - tempo.cor) \* (tempo.cor - cor.limit)** *# tempo.cor.loop - tempo.cor always positive and tempo.cor decreases progressively starting from tempo.cor.loop*

**final.exp <- as.POSIXct(final.loop, origin = tempo.date.loop)**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "WHILE LOOP | LOOP NB: ", format(count.loop, big.mark=","), " | COUNT: ", format(count, big.mark=","), " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4), " | TIME SPENT: ", tempo.lapse, " | EXPECTED END: ", final.exp))**

**}**

**}**

**}**

**}**

**tempo.time <- as.numeric(Sys.time())**

**tempo.lapse <- round(lubridate::seconds\_to\_period(tempo.time - ini.time))**

**cat(paste0("\n", ifelse(text.print == "", "", paste0(text.print, " | ")), "WHILE/FOR LOOPS END | LOOP COUNT: ", format(count, big.mark=","), " | NB OF ROUNDS: ", round, " | CORRELATION LIMIT: ", fun\_round(cor.limit, 4), " | ABS TEMPO CORRELATION: ", fun\_round(tempo.cor, 4), " | TOTAL SPENT TIME: ", tempo.lapse))**

**}**

**tempo.cor <- ifelse(neg.cor == TRUE, -tempo.cor, tempo.cor)**

**}**

**}**

**cat("\n\n")**

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**cat("\n\n")**

**}**

**output <- list(data = data1[tempo.pos], warnings = warnings, cor = if(is.null(data2)){cor(ini.pos, tempo.pos, method = "spearman")}else{tempo.cor}, count = count)**

**return(output)**

**}**

################ Graphics management

*# this order can be used:*

*# fun\_width()*

*# fun\_open()*

*# fun\_prior\_plot() # not for ggplot2*

*# plot() or any other plotting*

*# fun\_post\_plot() if fun\_prior\_plot() has been used # not for ggplot2*

*# fun\_close()*

######## fun\_width() #### window width depending on classes to plot

**# Check OK: clear to go Apollo**

**fun\_width <- function(class.nb, inches.per.class.nb = 1, ini.window.width = 7, inch.left.space, inch.right.space, boundarie.space = 0.5){**

*# AIM*

*# rescale the width of a window to open depending on the number of classes to plot*

*# can be used for height, considering that it is as if it was a width*

*# this order can be used:*

*# fun\_width()*

*# fun\_open()*

*# fun\_prior\_plot() # not for ggplot2*

*# plot() or any other plotting*

*# fun\_post\_plot() if fun\_prior\_plot() has been used # not for ggplot2*

*# fun\_close()*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# class.nb: number of class to plot*

*# inches.per.class.nb: number of inches per unit of class.nb. 2 means 2 inches for each boxplot for instance*

*# ini.window.width:initial window width in inches*

*# inch.left.space: left horizontal margin of the figure region (in inches)*

*# inch.right.space: right horizontal margin of the figure region (in inches)*

*# boundarie.space: space between the right and left limits of the plotting region and the plot (0.5 means half a class width)*

*# RETURN*

*# the new window width in inches*

*# EXAMPLES*

*# fun\_width(class.nb = 10, inches.per.class.nb = 0.2, ini.window.width = 7, inch.left.space = 1, inch.right.space = 1, boundarie.space = 0.5)*

*# DEBUGGING*

*# class.nb = 10 ; inches.per.class.nb = 0.2 ; ini.window.width = 7 ; inch.left.space = 1 ; inch.right.space = 1 ; boundarie.space = 0.5 # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = class.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = inches.per.class.nb, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = ini.window.width, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = inch.left.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = inch.right.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = boundarie.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**range.max <- class.nb + boundarie.space** *# the max range of the future plot*

**range.min <- boundarie.space** *# the min range of the future plot*

**window.width <- inch.left.space + inch.right.space + inches.per.class.nb \* (range.max - range.min)**

**return(window.width)**

**}**

######## fun\_open() #### open a GUI or pdf graphic window

**# Check OK: clear to go Apollo**

**fun\_open <- function(pdf.disp = TRUE, path.fun = "working.dir", pdf.name.file = "graph", width.fun = 7, height.fun = 7, paper = "special", no.pdf.overwrite = TRUE, return.output = FALSE){**

*# AIM*

*# open a pdf or screen (GUI) graphic window*

*# BEWARE: on Linux, use pdf.disp = TRUE, if (GUI) graphic window is not always available, meaning that X is not installed (clusters for instance). Use X11() in R to test if available*

*# this order can be used:*

*# fun\_width()*

*# fun\_open()*

*# fun\_prior\_plot() # not for ggplot2*

*# plot() or any other plotting*

*# fun\_post\_plot() if fun\_prior\_plot() has been used # not for ggplot2*

*# fun\_close()*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS:*

*# pdf.disp: use pdf or not*

*# path.fun: where the pdf is saved (do not terminate by / or \\). Write "working.dir" if working directory is required (default)*

*# pdf.name.file: name of the pdf file containing the graphs (the .pdf extension is added by the function)*

*# width.fun: width of the windows (in inches)*

*# height.fun: height of the windows (in inches)*

*# paper: paper argument of the pdf function (paper format). Only used for pdf(). Either "a4", "letter", "legal", "us", "executive", "a4r", "USr" or "special". If "special", means that width.fun and height.fun specify the paper size*

*# no.pdf.overwrite: existing pdf can be overwritten ? Only used if pdf.disp = TRUE*

*# return.output: return output ? If TRUE but function not assigned, the output list is displayed*

*# RETURN*

*# a list containing:*

*# $pdf.loc: path of the pdf created*

*# $ini.par: initial par() parameters (to reset in a new graph)*

*# $zone.ini: initial window spliting (to reset in a new graph)*

*# EXAMPLES*

*# fun\_open(pdf.disp = FALSE, path.fun = "C:/Users/Gael/Desktop", pdf.name.file = "graph", width.fun = 7, height.fun = 7, paper = "special", no.pdf.overwrite = TRUE, return.output = TRUE)*

*# DEBUGGING*

*# pdf.disp = TRUE ; path.fun = "C:/Users/Gael/Desktop" ; pdf.name.file = "graphs" ; width.fun = 7 ; height.fun = 7 ; paper = "special" ; no.pdf.overwrite = TRUE ; return.output = TRUE # for function debugging*

*# pdf.disp = TRUE ; path.fun = "/pasteur/homes/gmillot/" ; pdf.name.file = "graphs" ; width.fun = 7 ; height.fun = 7 ; paper = "special" ; no.pdf.overwrite = TRUE ; return.output = TRUE # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = pdf.disp, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = path.fun, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = pdf.name.file, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = width.fun, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = height.fun, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = path.fun, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = paper, options = c("a4", "letter", "legal", "us", "executive", "a4r", "USr", "special", "A4", "LETTER", "LEGAL", "US"), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data =no.pdf.overwrite, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = return.output, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**if(path.fun == "working.dir"){**

**path.fun <- getwd()**

**}else{**

**if(grepl(x = path.fun, pattern = ".+/$")){**

**path.fun <- substr(path.fun, 1, nchar(path.fun) - 1)** *# remove the last /*

**}**

**if(dir.exists(path.fun) == FALSE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": path.fun ARGUMENT DOES NOT CORRESPOND TO EXISTING DIRECTORY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if(Sys.info()["sysname"] == "Windows"){** *# Note that .Platform$OS.type() only says "unix" for macOS and Linux and "Windows" for Windows*

**open.fail <- NULL**

**windows()**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**}else if(Sys.info()["sysname"] == "Linux"){**

**if(pdf.disp == TRUE){**

**if(file.exists(paste0(path.fun, "/recover\_ini\_par.pdf"))){**

**tempo.cat <- paste0("\n\n================\n\nPROBLEM IN fun\_open(): THIS FUNCTION CANNOT BE USED ON LINUX IF A recover\_ini\_par.pdf FILE ALREADY EXISTS HERE: ", paste(path.fun, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**pdf(width = width.fun, height = height.fun, file=paste0(path.fun, "/recover\_ini\_par.pdf"), paper = paper)**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the pdf windows*

**file.remove(paste0(path.fun, "/recover\_ini\_par.pdf"))** *# remove the pdf file*

**}**

**}else{**

*# test if X11 can be opened*

**if(file.exists(paste0(getwd(), "/Rplots.pdf"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THIS FUNCTION CANNOT BE USED ON LINUX IF A Rplots.pdf FILE ALREADY EXISTS HERE: ", getwd(), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**open.fail <- suppressWarnings(try(X11(), silent = TRUE))[]** *# try to open a X11 window. If open.fail == NULL, no problem, meaning that the X11 window is opened. If open.fail != NULL, a pdf can be opened here paste0(getwd(), "/Rplots.pdf")*

**if(is.null(open.fail)){**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**}else if(file.exists(paste0(getwd(), "/Rplots.pdf"))){**

**file.remove(paste0(getwd(), "/Rplots.pdf"))** *# remove the pdf file*

**tempo.cat <- ("\n\n================\n\nPROBLEM IN fun\_open(): THIS FUNCTION CANNOT OPEN GUI ON LINUX OR NON MACOS UNIX SYSTEM (X GRAPHIC INTERFACE HAS TO BE SET).\nTO OVERCOME THIS, PLEASE SET pdf.disp ARGUMENT TO TRUE AND RERUN\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**}else{**

**open.fail <- NULL**

**quartz()**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**}**

**zone.ini <- matrix(1, ncol=1)** *# to recover the initial parameters for next figure region when device region split into several figure regions*

**if(pdf.disp == TRUE){**

**pdf.loc <- paste0(path.fun, "/", pdf.name.file, ".pdf")**

**if(file.exists(pdf.loc) == TRUE & no.pdf.overwrite == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": pdf.loc FILE ALREADY EXISTS AND CANNOT BE OVERWRITTEN DUE TO no.pdf.overwrite ARGUMENT SET TO TRUE: ", pdf.loc, "\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**pdf(width = width.fun, height = height.fun, file=pdf.loc, paper = paper)**

**}**

**}else if(pdf.disp == FALSE){**

**pdf.loc <- NULL**

**if(Sys.info()["sysname"] == "Windows"){** *# .Platform$OS.type() only says "unix" for macOS and Linux and "Windows" for Windows*

**windows(width = width.fun, height = height.fun, rescale="fixed")**

**}else if(Sys.info()["sysname"] == "Linux"){**

**if( ! is.null(open.fail)){**

**stop("\n\n================\n\nPROBLEM IN fun\_open(): THIS FUNCTION CANNOT OPEN GUI ON LINUX OR NON MACOS UNIX SYSTEM (X GRAPHIC INTERFACE HAS TO BE SET).\nTO OVERCOME THIS, PLEASE SET pdf.disp ARGUMENT TO TRUE AND RERUN\n\n================\n\n")**

**}else{**

**X11(width = width.fun, height = height.fun)**

**}**

**}else{**

**quartz(width = width.fun, height = height.fun)**

**}**

**}**

**if(return.output == TRUE){**

**output <- list(pdf.loc = pdf.loc, ini.par = ini.par, zone.ini = zone.ini)**

**return(output)**

**}**

**}**

######## fun\_prior\_plot() #### set graph param before plotting (erase axes for instance)

**# Check OK: clear to go Apollo**

**fun\_prior\_plot <- function(param.reinitial = FALSE, xlog.scale = FALSE, ylog.scale = FALSE, remove.label = TRUE, remove.x.axis = TRUE, remove.y.axis = TRUE, std.x.range = TRUE, std.y.range = TRUE, down.space = 1, left.space = 1, up.space = 1, right.space = 1, orient = 1, dist.legend = 3.5, tick.length = 0.5, box.type = "n", amplif.label = 1, amplif.axis = 1, display.extend = FALSE, return.par = FALSE){**

*# AIM*

*# very convenient to erase the axes for post plot axis redrawing using fun\_post\_plot()*

*# reinitialize and set the graphic parameters before plotting*

*# CANNOT be used if no graphic device already opened*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# param.reinitial: reinitialize graphic parameters before applying the new ones, as defined by the other arguments? Either TRUE or FALSE*

*# xlog.scale: Log scale for the x-axis? Either TRUE or FALSE. If TRUE, erases the x-axis, except legend, for further drawing by fun\_post\_plot()(xlog argument of par())*

*# ylog.scale: Log scale for the y-axis? Either TRUE or FALSE. If TRUE, erases the y-axis, except legend, for further drawing by fun\_post\_plot()(ylog argument of par())*

*# remove.label: remove labels (axis legend) of the two axes? Either TRUE or FALSE (ann argument of par())*

*# remove.x.axis: remove x-axis except legend? Either TRUE or FALSE (control the xaxt argument of par()). Automately set to TRUE if xlog.scale == TRUE*

*# remove.y.axis: remove y-axis except legend? Either TRUE or FALSE (control the yaxt argument of par()). Automately set to TRUE if ylog.scale == TRUE*

*# std.x.range: standard range on the x-axis? TRUE (no range extend) or FALSE (4% range extend). Controls xaxs argument of par() (TRUE is xaxs = "i", FALSE is xaxs = "r")*

*# std.y.range: standard range on the y-axis? TRUE (no range extend) or FALSE (4% range extend). Controls yaxs argument of par() (TRUE is yaxs = "i", FALSE is yaxs = "r")*

*# down.space: lower vertical margin (in inches, mai argument of par())*

*# left.space: left horizontal margin (in inches, mai argument of par())*

*# up.space: upper vertical margin between plot region and grapical window (in inches, mai argument of par())*

*# right.space: right horizontal margin (in inches, mai argument of par())*

*# orient: scale number orientation (las argument of par()). 0, always parallel to the axis; 1, always horizontal; 2, always perpendicular to the axis; 3, always vertical*

*# dist.legend: numeric value that moves axis legends away in inches (first number of mgp argument of par() but in inches thus / 0.2)*

*# tick.length: length of the ticks (1 means complete the distance between the plot region and the axis numbers, 0.5 means half the length, etc. 0 means no tick*

*# box.type: bty argument of par(). Either "o", "l", "7", "c", "u", "]", the resulting box resembles the corresponding upper case letter. A value of "n" suppresses the box*

*# amplif.label: increase or decrease the size of the text in legends*

*# amplif.axis: increase or decrease the size of the scale numbers in axis*

*# display.extend: extend display beyond plotting region? Either TRUE or FALSE (xpd argument of par() without NA)*

*# return.par: return graphic parameter modification?*

*# RETURN*

*# return graphic parameter modification*

*# EXAMPLES*

*# fun\_prior\_plot(param.reinitial = FALSE, xlog.scale = FALSE, ylog.scale = FALSE, remove.label = TRUE, remove.x.axis = TRUE, remove.y.axis = TRUE, std.x.range = TRUE, std.y.range = TRUE, down.space = 1, left.space = 1, up.space = 1, right.space = 1, orient = 1, dist.legend = 4.5, tick.length = 0.5, box.type = "n", amplif.label = 1, amplif.axis = 1, display.extend = FALSE, return.par = FALSE)*

*# DEBUGGING*

*# param.reinitial = FALSE ; xlog.scale = FALSE ; ylog.scale = FALSE ; remove.label = TRUE ; remove.x.axis = TRUE ; remove.y.axis = TRUE ; std.x.range = TRUE ; std.y.range = TRUE ; down.space = 1 ; left.space = 1 ; up.space = 1 ; right.space = 1 ; orient = 1 ; dist.legend = 4.5 ; tick.length = 0.5 ; box.type = "n" ; amplif.label = 1 ; amplif.axis = 1 ; display.extend = FALSE ; return.par = FALSE # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = param.reinitial, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = xlog.scale, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = ylog.scale, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = remove.label, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = remove.x.axis, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = remove.y.axis, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = std.x.range, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = std.y.range, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = down.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = left.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = up.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = right.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = orient, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dist.legend, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = tick.length, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = box.type, options = c("o", "l", "7", "c", "u", "]", "n"), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = amplif.label, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = amplif.axis, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = display.extend, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = return.par, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**if(is.null(dev.list())){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THIS FUNCTION CANNOT BE USED IF NO GRAPHIC DEVICE ALREADY OPENED (dev.list() IS CURRENTLY NULL)\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(param.reinitial == TRUE){**

**if( ! all(names(dev.cur()) == "null device")){**

**active.wind.nb <- dev.cur()**

**}else{**

**active.wind.nb <- 0**

**}**

**if(Sys.info()["sysname"] == "Windows"){** *# Note that .Platform$OS.type() only says "unix" for macOS and Linux and "Windows" for Windows*

**windows()**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**}else if(Sys.info()["sysname"] == "Linux"){**

**if(file.exists(paste0(getwd(), "/Rplots.pdf"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THIS FUNCTION CANNOT BE USED ON LINUX WITH param.reinitial SET TO TRUE IF A Rplots.pdf FILE ALREADY EXISTS HERE: ", getwd(), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**open.fail <- suppressWarnings(try(X11(), silent = TRUE))[]** *# try to open a X11 window. If open.fail == NULL, no problem, meaning that the X11 window is opened. If open.fail != NULL, a pdf can be opened here paste0(getwd(), "/Rplots.pdf")*

**if(is.null(open.fail)){**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**}else if(file.exists(paste0(getwd(), "/Rplots.pdf"))){**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**invisible(dev.off())** *# close the new window*

**file.remove(paste0(getwd(), "/Rplots.pdf"))** *# remove the pdf file*

**}else{**

**tempo.cat <- ("\n\n================\n\nPROBLEM IN fun\_prior\_plot(): THIS FUNCTION CANNOT OPEN GUI ON LINUX OR NON MACOS UNIX SYSTEM (X GRAPHIC INTERFACE HAS TO BE SET).\nTO OVERCOME THIS, PLEASE USE PDF GRAPHIC INTERFACES AND RERUN\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}else{** *# macOS*

**quartz()**

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened)*

**invisible(dev.off())** *# close the new window*

**}**

**if( ! all(names(dev.cur()) == "null device")){**

**dev.set(active.wind.nb)** *# go back to the active windows if exists*

**par(ini.par)** *# apply the initial par to current window*

**}**

**}**

**if(remove.x.axis == TRUE){**

**par(xaxt = "n")** *# suppress the y-axis label*

**}else{**

**par(xaxt = "s")**

**}**

**if(remove.y.axis == TRUE){**

**par(yaxt = "n")** *# suppress the y-axis label*

**}else{**

**par(yaxt = "s")**

**}**

**if(std.x.range == TRUE){**

**par(xaxs = "i")**

**}else{**

**par(xaxs = "r")**

**}**

**if(std.y.range == TRUE){**

**par(yaxs = "i")**

**}else{**

**par(yaxs = "r")**

**}**

**par(mai = c(down.space, left.space, up.space, right.space), ann = ! remove.label, las = orient, mgp = c(dist.legend/0.2, 1, 0), xpd = display.extend, bty= box.type, cex.lab = amplif.label, cex.axis = amplif.axis)**

**par(tcl = -par()$mgp[2] \* tick.length)** *# tcl gives the length of the ticks as proportion of line text, knowing that mgp is in text lines. So the main ticks are a 0.5 of the distance of the axis numbers by default. The sign provides the side of the tick (negative for outside of the plot region)*

**if(xlog.scale == TRUE){**

**par(xaxt = "n", xlog = TRUE)** *# suppress the x-axis label*

**}else{**

**par(xlog = FALSE)**

**}**

**if(ylog.scale == TRUE){**

**par(yaxt = "n", ylog = TRUE)** *# suppress the y-axis label*

**}else{**

**par(ylog = FALSE)**

**}**

**if(return.par == TRUE){**

**tempo.par <- par()**

**return(tempo.par)**

**}**

**}**

######## fun\_scale() #### select nice label numbers when setting number of ticks on an axis



**# Check OK: clear to go Apollo**

**fun\_scale <- function(n, lim, kind = "approx", path.lib = NULL){**

*# AIM*

*# attempt to select nice scale numbers when setting n ticks on a lim axis range*

*# ARGUMENTS*

*# n: desired number of main ticks on the axis (integer more than 0)*

*# lim: vector of 2 numbers indicating the limit range of the axis. Order of the 2 values matters (for inverted axis). Can be log transformed values*

*# kind: either "approx" (approximative), "strict" (strict) or "strict.cl" (strict clean). If "approx", use the scales::trans\_breaks() function to provide an easy to read scale of approximately n ticks spanning the range of the lim argument. If "strict", cut the range of the lim argument into n + 1 equidistant part and return the n numbers at each boundary. This often generates numbers uneasy to read. If "strict.cl", provide an easy to read scale of exactly n ticks, but sometimes not completely spanning the range of the lim argument*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# if kind = "approx":*

*# ggplot2*

*# scales*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_round()*

*# RETURN*

*# a vector of numbers*

*# EXAMPLES*

*# approximate number of main ticks*

*# ymin = 2 ; ymax = 3.101 ; n = 5 ; scale <- fun\_scale(n = n, lim = c(ymin, ymax), kind = "approx") ; scale ; par(yaxt = "n", yaxs = "i", las = 1) ; plot(ymin:ymax, ymin:ymax, xlim = range(scale, ymin, ymax)[order(c(ymin, ymax))], ylim = range(scale, ymin, ymax)[order(c(ymin, ymax))], xlab = "DEFAULT SCALE", ylab = "NEW SCALE") ; par(yaxt = "s") ; axis(side = 2, at = scale)*

*# strict number of main ticks*

*# ymin = 2 ; ymax = 3.101 ; n = 5 ; scale <- fun\_scale(n = n, lim = c(ymin, ymax), kind = "strict") ; scale ; par(yaxt = "n", yaxs = "i", las = 1) ; plot(ymin:ymax, ymin:ymax, xlim = range(scale, ymin, ymax)[order(c(ymin, ymax))], ylim = range(scale, ymin, ymax)[order(c(ymin, ymax))], xlab = "DEFAULT SCALE", ylab = "NEW SCALE") ; par(yaxt = "s") ; axis(side = 2, at = scale)*

*# strict "clean" number of main ticks*

*# ymin = 2 ; ymax = 3.101 ; n = 5 ; scale <- fun\_scale(n = n, lim = c(ymin, ymax), kind = "strict.cl") ; scale ; par(yaxt = "n", yaxs = "i", las = 1) ; plot(ymin:ymax, ymin:ymax, xlim = range(scale, ymin, ymax)[order(c(ymin, ymax))], ylim = range(scale, ymin, ymax)[order(c(ymin, ymax))], xlab = "DEFAULT SCALE", ylab = "NEW SCALE") ; par(yaxt = "s") ; axis(side = 2, at = scale)*

*# approximate number of main ticks, scale inversion*

*# ymin = 3.101 ; ymax = 2 ; n = 5 ; scale <- fun\_scale(n = n, lim = c(ymin, ymax), kind = "approx") ; scale ; par(yaxt = "n", yaxs = "i", las = 1) ; plot(ymin:ymax, ymin:ymax, xlim = range(scale, ymin, ymax)[order(c(ymin, ymax))], ylim = range(scale, ymin, ymax)[order(c(ymin, ymax))], xlab = "DEFAULT SCALE", ylab = "NEW SCALE") ; par(yaxt = "s") ; axis(side = 2, at = scale)*

*# DEBUGGING*

*# n = 9 ; lim = c(2, 3.101) ; kind = "approx" ; path.lib = NULL # for function debugging*

*# n = 10 ; lim = c(1e-4, 1e6) ; kind = "approx" ; path.lib = NULL # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# end initial argument checking*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = n, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & n == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": n ARGUMENT MUST BE A NON NULL AND POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)** *#*

**}**

**tempo <- fun\_check(data = lim, class = "vector", mode = "numeric", length = 2, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & diff(lim) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": lim ARGUMENT HAS A NULL RANGE (2 IDENTICAL VALUES)\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & any(lim %in% c(Inf, -Inf))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": lim ARGUMENT CANNOT CONTAIN -Inf OR Inf VALUES\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = kind, options = c("approx", "strict", "strict.cl"), length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**lim.order <- order(lim)** *# to deal with inverted axis*

**lim <- sort(lim)**

**if(kind == "approx"){**

*# package checking*

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

**fun\_pack(req.package = c("scales"), path.lib = path.lib)**

*# end package checking*

**output <- ggplot2::ggplot\_build(ggplot2::ggplot() + ggplot2::scale\_y\_continuous(**

**breaks = scales::trans\_breaks(**

**trans = "identity",**

**inv = "identity",**

**n = n**

**),**

**limits = lim**

**))$layout$panel\_params[[1]]$y.major\_source** *# pretty() alone is not appropriate: tempo.pret <- pretty(seq(lim[1] ,lim[2], length.out = n)) ; tempo.pret[tempo.pret > = lim[1] & tempo.pret < = lim[2]]*

**}else if(kind == "strict"){**

**output <- fun\_round(seq(lim[1] ,lim[2], length.out = n), 2)**

**}else if(kind == "strict.cl"){**

**tempo.range <- diff(sort(lim))**

**tempo.max <- max(lim)**

**tempo.min <- min(lim)**

**mid <- tempo.min + (tempo.range/2)** *# middle of axis*

**tempo.inter <- tempo.range / (n + 1)** *# current interval between two ticks, between 0 and Inf*

**if(tempo.inter == 0){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": THE INTERVAL BETWEEN TWO TICKS OF THE SCALE IS NULL. MODIFY THE lim OR n ARGUMENT\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**log10.abs.lim <- 200**

**log10.range <- (-log10.abs.lim):log10.abs.lim**

**log10.vec <- 10^log10.range**

**round.vec <- c(5, 4, 3, 2.5, 2, 1.25, 1)**

**dec.table <- outer(log10.vec, round.vec)** *# table containing the scale units (row: power of ten from -201 to +199, column: the 5, 2.5, 2, 1.25, 1 notches*



*# recover the number of leading zeros in tempo.inter*

**ini.scipen <- options()$scipen**

**options(scipen = -1000)** *# force scientific format*

**if(any(grepl(pattern = "\\+", x = tempo.inter))){ # tempo.inter > 1**

**power10.exp <- as.integer(substring(text = tempo.inter, first = (regexpr(pattern = "\\+", text = tempo.inter) + 1)))** *# recover the power of 10. Example recover 08 from 1e+08*

**mantisse <- as.numeric(substr(x = tempo.inter, start = 1, stop = (regexpr(pattern = "\\+", text = tempo.inter) - 2)))** *# recover the mantisse. Example recover 1.22 from 1.22e+08*

**}else if(any(grepl(pattern = "\\-", x = tempo.inter))){ # tempo.inter < 1**

**power10.exp <- as.integer(substring(text = tempo.inter, first = (regexpr(pattern = "\\-", text = tempo.inter))))** *# recover the power of 10. Example recover 08 from 1e+08*

**mantisse <- as.numeric(substr(x = tempo.inter, start = 1, stop = (regexpr(pattern = "\\-", text = tempo.inter) - 2)))** *# recover the mantisse. Example recover 1.22 from 1.22e+08*

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 1\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**tempo.scale <- dec.table[log10.range == power10.exp, ]**

*# new interval*

**inter.select <- NULL**

**for(i1 in 1:length(tempo.scale)){**

**tempo.first.tick <- trunc((tempo.min + tempo.scale[i1]) / tempo.scale[i1]) \* (tempo.scale[i1])** *# this would be use to have a number not multiple of tempo.scale[i1]: ceiling(tempo.min) + tempo.scale[i1] \* 10^power10.exp*

**tempo.last.tick <- tempo.first.tick + tempo.scale[i1] \* (n - 1)**

**if((tempo.first.tick >= tempo.min) & (tempo.last.tick <= tempo.max)){**

**inter.select <- tempo.scale[i1]**

**break()**

**}**

**}**

**if(is.null(inter.select)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**options(scipen = ini.scipen)** *# restore the initial scientific penalty*

*# end new interval*

*# centering the new scale*

**tempo.mid <- trunc((mid + (-1:1) \* inter.select) / inter.select) \* inter.select** *# tempo middle tick closest to the middle axis*

**mid.tick <- tempo.mid[which.min(abs(tempo.mid - mid))]**

**if(n == 1){**

**output <- mid.tick**

**}else if(n == 2){**

**tempo.min.dist <- mid.tick - inter.select - tempo.min**

**tempo.max.dist <- tempo.max - mid.tick + inter.select**

**if(tempo.min.dist <= tempo.max.dist){** *# distance between lowest tick and bottom axis <= distance between highest tick and top axis. If yes, extra tick but at the top, otherwise at the bottom*

**output <- c(mid.tick, mid.tick + inter.select)**

**}else{**

**output <- c(mid.tick - inter.select, mid.tick)**

**}**

**}else if((n / 2 - trunc(n / 2)) > 0.1){** *# > 0.1 to avoid floating point. Because result can only be 0 or 0.5. Thus, > 0.1 means odd number*

**output <- c(mid.tick - (trunc(n / 2):1) \* inter.select, mid.tick, mid.tick + (1:trunc(n / 2)) \* inter.select)**

**}else if((n / 2 - trunc(n / 2)) < 0.1){** *# < 0.1 to avoid floating point. Because result can only be 0 or 0.5. Thus, < 0.1 means even number*

**tempo.min.dist <- mid.tick - trunc(n / 2) \* inter.select - tempo.min**

**tempo.max.dist <- tempo.max - mid.tick + trunc(n / 2) \* inter.select**

**if(tempo.min.dist <= tempo.max.dist){** *# distance between lowest tick and bottom axis <= distance between highest tick and top axis. If yes, extra tick but at the bottom, otherwise at the top*

**output <- c(mid.tick - ((trunc(n / 2) - 1):1) \* inter.select, mid.tick, mid.tick + (1:trunc(n / 2)) \* inter.select)**

**}else{**

**output <- c(mid.tick - (trunc(n / 2):1) \* inter.select, mid.tick, mid.tick + (1:(trunc(n / 2) - 1)) \* inter.select)**

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 3\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# end centering the new scale*

*# last check*

**if(min(output) < tempo.min){**

**output <- c(output[-1], max(output) + inter.select)** *# remove the lowest tick and add a tick at the top*

**}else if( max(output) > tempo.max){**

**output <- c(min(output) - inter.select, output[-length(output)])**

**}**

**if(min(output) < tempo.min | max(output) > tempo.max){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 4\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(is.na(output))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 5 (NA GENERATION)\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# end last check*

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 6\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(diff(lim.order) < 0){**

**output <- rev(output)**

**}**

**return(output)**

**}**

######## fun\_post\_plot() #### set graph param after plotting (axes redesign for instance)

****

**# Check OK: clear to go Apollo**

**fun\_post\_plot <- function(x.side = 0, x.log.scale = FALSE, x.categ = NULL, x.categ.pos = NULL, x.lab = "", x.axis.magnific = 1.5, x.label.magnific = 1.5, x.dist.legend = 0.5, x.nb.inter.tick = 1, y.side = 0, y.log.scale = FALSE, y.categ = NULL, y.categ.pos = NULL, y.lab = "", y.axis.magnific = 1.5, y.label.magnific = 1.5, y.dist.legend = 0.5, y.nb.inter.tick = 1, text.angle = 90, tick.length = 0.5, sec.tick.length = 0.3, bg.color = NULL, grid.lwd = NULL, grid.col = "white", corner.text = "", magnific.corner.text = 1, just.label.add = FALSE, par.reset = FALSE, custom.par = NULL){**

*# AIM*

*# redesign axis. If x.side = 0, y.side = 0, the function just adds text at topright of the graph and reset par() for next graphics and provides outputs (see below)*

*# provide also positions for legend or additional text on the graph*

*# use fun\_prior\_plot() before this function for initial inactivation of the axis drawings*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_open() to reinitialize graph parameters if par.reset = TRUE and custom.par = NULL*

*# ARGUMENTS*

*# x.side: axis at the bottom (1) or top (3) of the region figure. Write 0 for no change*

*# x.log.scale: Log scale for the x-axis? Either TRUE or FALSE*

*# x.categ: character vector representing the classes (levels()) to specify when the x-axis is qualititative(stripchart, boxplot)*

*# x.categ.pos: position of the classes names (numeric vector of identical length than x.categ). If left NULL, this will be 1:length(levels())*

*# x.lab: label of the x-axis. If x.side == 0 and x.lab != "", then x.lab is printed*

*# x.axis.magnific: increase or decrease the value to increase or decrease the size of the x axis numbers. Also control the size of displayed categories*

*# x.label.magnific: increase or decrease the value to increase or decrease the size of the x axis legend*

*# x.dist.legend: increase the number to move x-axis legends away in inches (first number of mgp argument of par() but in inches)*

*# x.nb.inter.tick: number of secondary ticks between main ticks on x-axis (only if not log scale). 0 means no secondary ticks*

*# y.side: axis at the left (2) or right (4) of the region figure. Write 0 for no change*

*# y.log.scale: Log scale for the y-axis? Either TRUE or FALSE*

*# y.categ: classes (levels()) to specify when the y-axis is qualititative(stripchart, boxplot)*

*# y.categ.pos: position of the classes names (numeric vector of identical length than y.categ). If left NULL, this will be 1:length(levels())*

*# y.lab: label of the y-axis. If y.side == 0 and y.lab != "", then y.lab is printed*

*# y.axis.magnific: increase or decrease the value to increase or decrease the size of the y axis numbers. Also control the size of displayed categories*

*# y.label.magnific: increase or decrease the value to increase or decrease the size of the y axis legend*

*# y.dist.legend: increase the number to move y-axis legends away in inches (first number of mgp argument of par() but in inches)*

*# y.nb.inter.tick: number of secondary ticks between main ticks on y-axis (only if not log scale). 0 means non secondary ticks*

*# text.angle: angle of the text when axis is qualitative*

*# tick.length: length of the main ticks (1 means complete the distance between the plot region and the axis numbers, 0.5 means half the length, etc., 0 for no ticks)*

*# sec.tick.length: length of the secondary ticks (1 means complete the distance between the plot region and the axis numbers, 0.5 means half the length, etc., 0 for no ticks)*

*# bg.color: background color of the plot region. NULL for no color. BEWARE: cover/hide an existing plot !*

*# grid.lwd: if non NULL, activate the grid line (specify the line width)*

*# grid.col: grid line color (only if grid.lwd non NULL)*

*# corner.text: text to add at the top right corner of the window*

*# magnific.corner.text: increase or decrease the size of the text*

*# par.reset: to reset all the graphics parameters. BEWARE: TRUE can generate display problems, mainly in graphic devices with multiple figure regions*

*# just.label.add: just add axis labels (legend)? Either TRUE or FALSE. If TRUE, at least (x.side == 0 & x.lab != "") or (y.side == 0 & y.lab != "") must be set to display the corresponding x.lab or y.lab*

*# custom.par: list that provides the parameters that reset all the graphics parameters. BEWARE: if NULL and par.reset == TRUE, the default par() parameters are used*

*# RETURN*

*# a list containing:*

*# $x.mid.left.dev.region: middle of the left margin of the device region, in coordinates of the x-axis*

*# $x.left.dev.region: left side of the left margin (including the potential margin of the device region), in coordinates of the x-axis*

*# $x.mid.right.dev.region: middle of the right margin of the device region, in coordinates of the x-axis*

*# $x.right.dev.region: right side of the right margin (including the potential margin of the device region), in coordinates of the x-axis*

*# $x.mid.left.fig.region: middle of the left margin of the figure region, in coordinates of the x-axis*

*# $x.left.fig.region: left side of the left margin, in coordinates of the x-axis*

*# $x.mid.right.fig.region: middle of the right margin of the figure region, in coordinates of the x-axis*

*# $x.right.fig.region: right side of the right margin, in coordinates of the x-axis*

*# $x.left.plot.region: left side of the plot region, in coordinates of the x-axis*

*# $x.right.plot.region: right side of the plot region, in coordinates of the x-axis*

*# $x.mid.plot.region: middle of the plot region, in coordinates of the x-axis*

*# $y.mid.bottom.dev.region: middle of the bottom margin of the device region, in coordinates of the y-axis*

*# $y.bottom.dev.region: bottom side of the bottom margin (including the potential margin of the device region), in coordinates of the y-axis*

*# $y.mid.top.dev.region: middle of the top margin of the device region, in coordinates of the y-axis*

*# $y.top.dev.region: top side of the top margin (including the potential margin of the device region), in coordinates of the y-axis*

*# $y.mid.bottom.fig.region: middle of the bottom margin of the figure region, in coordinates of the y-axis*

*# $y.bottom.fig.region: bottom of the bottom margin of the figure region, in coordinates of the y-axis*

*# $y.mid.top.fig.region: middle of the top margin of the figure region, in coordinates of the y-axis*

*# $y.top.fig.region: top of the top margin of the figure region, in coordinates of the y-axis*

*# $y.top.plot.region: top of the plot region, in coordinates of the y-axis*

*# $y.bottom.plot.region: bottom of the plot region, in coordinates of the y-axis*

*# $y.mid.plot.region: middle of the plot region, in coordinates of the y-axis*

*# $text: warning text*

*# EXAMPLES*

*# Example of log axis with log y-axis and unmodified x-axis:*

*# prior.par <- fun\_prior\_plot(param.reinitial = TRUE, xlog.scale = FALSE, ylog.scale = TRUE, remove.label = TRUE, remove.x.axis = FALSE, remove.y.axis = TRUE, down.space = 1, left.space = 1, up.space = 1, right.space = 1, orient = 1, dist.legend = 0.5, tick.length = 0.5, box.type = "n", amplif.label = 1, amplif.axis = 1, display.extend = FALSE, return.par = TRUE) ; plot(1:100, log = "y") ; fun\_post\_plot(y.side = 2, y.log.scale = prior.par$ylog, x.lab = "Values", y.lab = "TEST", y.axis.magnific = 1.25, y.label.magnific = 1.5, y.dist.legend = 0.7, just.label.add = ! prior.par$ann)*

*# Example of log axis with redrawn x-axis and y-axis:*

*# prior.par <- fun\_prior\_plot(param.reinitial = TRUE) ; plot(1:100) ; fun\_post\_plot(x.side = 1, x.lab = "Values", y.side = 2, y.lab = "TEST", y.axis.magnific = 1, y.label.magnific = 2, y.dist.legend = 0.6)*

*# example with margins in the device region:*

*# windows(5,5) ; fun\_prior\_plot(box.type = "o") ; par(mai=c(0.5,0.5,0.5,0.5), omi = c(0.25,0.25,1,0.25), xaxs = "i", yaxs = "i") ; plot(0:10) ; a <- fun\_post\_plot(x.side = 0, y.side = 0) ; x <- c(a$x.mid.left.dev.region, a$x.left.dev.region, a$x.mid.right.dev.region, a$x.right.dev.region, a$x.mid.left.fig.region, a$x.left.fig.region, a$x.mid.right.fig.region, a$x.right.fig.region, a$x.right.plot.region, a$x.left.plot.region, a$x.mid.plot.region) ; y <- c(a$y.mid.bottom.dev.region, a$y.bottom.dev.region, a$y.mid.top.dev.region, a$y.top.dev.region, a$y.mid.bottom.fig.region, a$y.bottom.fig.region, a$y.mid.top.fig.region, a$y.top.fig.region, a$y.top.plot.region, a$y.bottom.plot.region, a$y.mid.plot.region) ; par(xpd = NA) ; points(x = rep(5, length(y)), y = y, pch = 16, col = "red") ; text(x = rep(5, length(y)), y = y, c("y.mid.bottom.dev.region", "y.bottom.dev.region", "y.mid.top.dev.region", "y.top.dev.region", "y.mid.bottom.fig.region", "y.bottom.fig.region", "y.mid.top.fig.region", "y.top.fig.region", "y.top.plot.region", "y.bottom.plot.region", "y.mid.plot.region"), cex = 0.65, col = grey(0.25)) ; points(y = rep(5, length(x)), x = x, pch = 16, col = "blue") ; text(y = rep(5, length(x)), x = x, c("x.mid.left.dev.region", "x.left.dev.region", "x.mid.right.dev.region", "x.right.dev.region", "x.mid.left.fig.region", "x.left.fig.region", "x.mid.right.fig.region", "x.right.fig.region", "x.right.plot.region", "x.left.plot.region", "x.mid.plot.region"), cex = 0.65, srt = 90, col = grey(0.25))*

*# DEBUGGING*

*# x.side = 0 ; x.log.scale = FALSE ; x.categ = NULL ; x.categ.pos = NULL ; x.lab = "" ; x.axis.magnific = 1.5 ; x.label.magnific = 1.5 ; x.dist.legend = 1 ; x.nb.inter.tick = 1 ; y.side = 0 ; y.log.scale = FALSE ; y.categ = NULL ; y.categ.pos = NULL ; y.lab = "" ; y.axis.magnific = 1.5 ; y.label.magnific = 1.5 ; y.dist.legend = 0.7 ; y.nb.inter.tick = 1 ; text.angle = 90 ; tick.length = 0.5 ; sec.tick.length = 0.3 ; bg.color = NULL ; grid.lwd = NULL ; grid.col = "white" ; corner.text = "" ; magnific.corner.text = 1 ; just.label.add = FALSE ; par.reset = FALSE ; custom.par = NULL # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_open", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_open() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = x.side, options = c(0, 1, 3), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.log.scale, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(x.categ)){**

**tempo <- fun\_check(data = x.categ, class = "character", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(x.categ.pos)){**

**tempo <- fun\_check(data = x.categ.pos, class = "vector", mode = "numeric", fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = x.lab, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.axis.magnific, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.label.magnific, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.dist.legend, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.nb.inter.tick, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.side, options = c(0, 2, 4), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.log.scale, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(y.categ)){**

**tempo <- fun\_check(data = y.categ, class = "character", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(y.categ.pos)){**

**tempo <- fun\_check(data = y.categ.pos, class = "vector", mode = "numeric", fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = y.lab, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.axis.magnific, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.label.magnific, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.dist.legend, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.nb.inter.tick, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = text.angle, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = tick.length, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = sec.tick.length, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**if( ! is.null(bg.color)){**

**tempo <- fun\_check(data = bg.color, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! (bg.color %in% colors() | grepl(pattern = "^#", bg.color))){** *# check color*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": bg.color ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # OR A COLOR NAME GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(grid.lwd)){**

**tempo <- fun\_check(data = grid.lwd, class = "vector", mode = "numeric", neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(grid.col)){**

**tempo <- fun\_check(data = grid.col, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! (grid.col %in% colors() | grepl(pattern = "^#", grid.col))){** *# check color*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": grid.col ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # OR A COLOR NAME GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = corner.text, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = magnific.corner.text, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = just.label.add, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = par.reset, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(custom.par)){**

**tempo <- fun\_check(data = custom.par, typeof = "list", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**text <- NULL**

**par(tcl = -par()$mgp[2] \* tick.length)**

**if(x.log.scale == TRUE){**

**grid.coord.x <- c(10^par("usr")[1], 10^par("usr")[2])**

**}else{**

**grid.coord.x <- c(par("usr")[1], par("usr")[2])**

**}**

**if(y.log.scale == TRUE){**

**grid.coord.y <- c(10^par("usr")[3], 10^par("usr")[4])**

**}else{**

**grid.coord.y <- c(par("usr")[3], par("usr")[4])**

**}**

**if( ! is.null(bg.color)){**

**rect(grid.coord.x[1], grid.coord.y[1], grid.coord.x[2], grid.coord.y[2], col = bg.color, border = NA)**

**}**

**if( ! is.null(grid.lwd)){**

**grid(nx = NA, ny = NULL, col = grid.col, lty = 1, lwd = grid.lwd)**

**}**

**if(x.log.scale == TRUE){**

**x.mid.left.dev.region <- 10^(par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* par("omd")[1] / 2)** *# in x coordinates, to position axis labeling at the bottom of the graph (according to x scale)*

**x.left.dev.region <- 10^(par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* par("omd")[1])** *# in x coordinates*

**x.mid.right.dev.region <- 10^(par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) + ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* (1 - par("omd")[2]) / 2)** *# in x coordinates, to position axis labeling at the top of the graph (according to x scale)*

**x.right.dev.region <- 10^(par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) + ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* (1 - par("omd")[2]))** *# in x coordinates*

**x.mid.left.fig.region <- 10^(par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] / 2)** *# in x coordinates, to position axis labeling at the bottom of the graph (according to x scale)*

**x.left.fig.region <- 10^(par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1])** *# in x coordinates*

**x.mid.right.fig.region <- 10^(par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) / 2)** *# in x coordinates, to position axis labeling at the top of the graph (according to x scale)*

**x.right.fig.region <- 10^(par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]))** *# in x coordinates*

**x.left.plot.region <- 10^par("usr")[1]** *# in x coordinates, left of the plot region (according to x scale)*

**x.right.plot.region <- 10^par("usr")[2]** *# in x coordinates, right of the plot region (according to x scale)*

**x.mid.plot.region <- 10^((par("usr")[2] + par("usr")[1]) / 2)** *# in x coordinates, right of the plot region (according to x scale)*

**}else{**

**x.mid.left.dev.region <- (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* par("omd")[1] / 2)** *# in x coordinates, to position axis labeling at the bottom of the graph (according to x scale)*

**x.left.dev.region <- (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* par("omd")[1])** *# in x coordinates*

**x.mid.right.dev.region <- (par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) + ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* (1 - par("omd")[2]) / 2)** *# in x coordinates, to position axis labeling at the top of the graph (according to x scale)*

**x.right.dev.region <- (par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) + ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* (1 - par("omd")[2]))** *# in x coordinates*

**x.mid.left.fig.region <- (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] / 2)** *# in x coordinates, to position axis labeling at the bottom of the graph (according to x scale)*

**x.left.fig.region <- (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1])** *# in x coordinates*

**x.mid.right.fig.region <- (par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]) / 2)** *# in x coordinates, to position axis labeling at the top of the graph (according to x scale)*

**x.right.fig.region <- (par("usr")[2] + ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* (1 - par("plt")[2]))** *# in x coordinates*

**x.left.plot.region <- par("usr")[1]** *# in x coordinates, left of the plot region (according to x scale)*

**x.right.plot.region <- par("usr")[2]** *# in x coordinates, right of the plot region (according to x scale)*

**x.mid.plot.region <- (par("usr")[2] + par("usr")[1]) / 2** *# in x coordinates, right of the plot region (according to x scale)*

**}**

**if(y.log.scale == TRUE){**

**y.mid.bottom.dev.region <- 10^(par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] - ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (par("omd")[3] / 2))** *# in y coordinates, to position axis labeling at the bottom of the graph (according to y scale). Ex mid.bottom.space*

**y.bottom.dev.region <- 10^(par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] - ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* par("omd")[3])** *# in y coordinates*

**y.mid.top.dev.region <- 10^(par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (1 - par("omd")[4]) / 2)** *# in y coordinates, to position axis labeling at the top of the graph (according to y scale). Ex mid.top.space*

**y.top.dev.region <- 10^(par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (1 - par("omd")[4]))** *# in y coordinates*

**y.mid.bottom.fig.region <- 10^(par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] / 2)** *# in y coordinates, to position axis labeling at the bottom of the graph (according to y scale). Ex mid.bottom.space*

**y.bottom.fig.region <- 10^(par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3])** *# in y coordinates*

**y.mid.top.fig.region <- 10^(par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) / 2)** *# in y coordinates, to position axis labeling at the top of the graph (according to y scale). Ex mid.top.space*

**y.top.fig.region <- 10^(par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]))** *# in y coordinates*

**y.top.plot.region <- 10^par("usr")[4]** *# in y coordinates, top of the plot region (according to y scale)*

**y.bottom.plot.region <- 10^par("usr")[3]** *# in y coordinates, bottom of the plot region (according to y scale)*

**y.mid.plot.region <- (par("usr")[3] + par("usr")[4]) / 2** *# in x coordinates, right of the plot region (according to x scale)*

**}else{**

**y.mid.bottom.dev.region <- (par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] - ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (par("omd")[3] / 2))** *# in y coordinates, to position axis labeling at the bottom of the graph (according to y scale). Ex mid.bottom.space*

**y.bottom.dev.region <- (par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] - ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* par("omd")[3])** *# in y coordinates*

**y.mid.top.dev.region <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (1 - par("omd")[4]) / 2)** *# in y coordinates, to position axis labeling at the top of the graph (according to y scale). Ex mid.top.space*

**y.top.dev.region <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (1 - par("omd")[4]))** *# in y coordinates*

**y.mid.bottom.fig.region <- (par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3] / 2)** *# in y coordinates, to position axis labeling at the bottom of the graph (according to y scale). Ex mid.bottom.space*

**y.bottom.fig.region <- (par("usr")[3] - ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* par("plt")[3])** *# in y coordinates*

**y.mid.top.fig.region <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) / 2)** *# in y coordinates, to position axis labeling at the top of the graph (according to y scale). Ex mid.top.space*

**y.top.fig.region <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]))** *# in y coordinates*

**y.top.plot.region <- par("usr")[4]** *# in y coordinates, top of the plot region (according to y scale)*

**y.bottom.plot.region <- par("usr")[3]** *# in y coordinates, bottom of the plot region (according to y scale)*

**y.mid.plot.region <- ((par("usr")[3] + par("usr")[4]) / 2)** *# in x coordinates, right of the plot region (according to x scale)*

**}**

**if(x.side == 1 | x.side == 3){**

**par(xpd=FALSE, xaxt="s")**

**if(is.null(x.categ) & x.log.scale == TRUE){**

**if(any(par()$xaxp[1:2] == 0)){**

**if(par()$xaxp[1] == 0){**

**par(xaxp = c(10^-30, par()$xaxp[2:3]))** *# because log10(par()$xaxp[1] == 0) == -Inf*

**}**

**if(par()$xaxp[2] == 0){**

**par(xaxp = c(par()$xaxp[1], 10^-30, par()$xaxp[3]))** *# because log10(par()$xaxp[2] == 0) == -Inf*

**}**

**}**

**axis(side=x.side, at=c(10^par()$usr[1], 10^par()$usr[2]), labels=rep("", 2), lwd=1, lwd.ticks=0)** *# draw the axis line*

**mtext(side = x.side, text = x.lab, line = x.dist.legend / 0.2, las = 0, cex = x.label.magnific)**

**par(tcl = -par()$mgp[2] \* sec.tick.length)** *# length of the secondary ticks are reduced*

**suppressWarnings(rug(10^outer(c((log10(par("xaxp")[1]) -1):log10(par("xaxp")[2])), log10(1:10), "+"), ticksize = NA, side = x.side))** *# ticksize = NA to allow the use of par()$tcl value*

**par(tcl = -par()$mgp[2] \* tick.length)** *# back to main ticks*

**axis(side = x.side, at = c(1e-15, 1e-14, 1e-13, 1e-12, 1e-11, 1e-10, 1e-9, 1e-8, 1e-7, 1e-6, 1e-5, 1e-4, 1e-3, 1e-2, 1e-1, 1e0, 1e1, 1e2, 1e3, 1e4, 1e5, 1e6, 1e7, 1e8, 1e9, 1e10), labels = expression(10^-15, 10^-14, 10^-13, 10^-12, 10^-11, 10^-10, 10^-9, 10^-8, 10^-7, 10^-6, 10^-5, 10^-4, 10^-3, 10^-2, 10^-1, 10^0, 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, 10^9, 10^10), lwd = 0, lwd.ticks = 1, cex.axis = x.axis.magnific)**

**x.text <- 10^par("usr")[2]**

**}else if(is.null(x.categ) & x.log.scale == FALSE){**

**axis(side=x.side, at=c(par()$usr[1], par()$usr[2]), labels=rep("", 2), lwd=1, lwd.ticks=0)** *# draw the axis line*

**axis(side=x.side, at=round(seq(par()$xaxp[1], par()$xaxp[2], length.out=par()$xaxp[3]+1), 2), cex.axis = x.axis.magnific)** *# axis(side=x.side, at=round(seq(par()$xaxp[1], par()$xaxp[2], length.out=par()$xaxp[3]+1), 2), labels = format(round(seq(par()$xaxp[1], par()$xaxp[2], length.out=par()$xaxp[3]+1), 2), big.mark=','), cex.axis = x.axis.magnific) # to get the 1000 comma separator*

**mtext(side = x.side, text = x.lab, line = x.dist.legend / 0.2, las = 0, cex = x.label.magnific)**

**if(x.nb.inter.tick > 0){**

**inter.tick.unit <- (par("xaxp")[2] - par("xaxp")[1]) / par("xaxp")[3]**

**par(tcl = -par()$mgp[2] \* sec.tick.length)** *# length of the ticks are reduced*

**suppressWarnings(rug(seq(par("xaxp")[1] - 10 \* inter.tick.unit, par("xaxp")[2] + 10 \* inter.tick.unit, by = inter.tick.unit / (1 + x.nb.inter.tick)), ticksize = NA, x.side))** *# ticksize = NA to allow the use of par()$tcl value*

**par(tcl = -par()$mgp[2] \* tick.length)** *# back to main ticks*

**}**

**x.text <- par("usr")[2]**

**}else if(( ! is.null(x.categ)) & x.log.scale == FALSE){**

**if(is.null(x.categ.pos)){**

**x.categ.pos <- 1:length(x.categ)**

**}else if(length(x.categ.pos) != length(x.categ)){**

**stop("\n\nPROBLEM: x.categ.pos MUST BE THE SAME LENGTH AS x.categ\n\n")**

**}**

**par(xpd = TRUE)**

**if(x.side == 1){**

**segments(x0 = x.left.plot.region, x1 = x.right.plot.region, y0 = y.bottom.plot.region, y1 = y.bottom.plot.region)** *# draw the line of the axis*

**text(x = x.categ.pos, y = y.mid.bottom.fig.region, labels = x.categ, srt = text.angle, cex = x.axis.magnific)**

**}else if(x.side == 3){**

**segments(x0 = x.left.plot.region, x1 = x.right.plot.region, y0 = y.top.plot.region, y1 = y.top.plot.region)** *# draw the line of the axis*

**text(x = x.categ.pos, y = y.mid.top.fig.region, labels = x.categ, srt = text.angle, cex = x.axis.magnific)**

**}else{**

**stop("\n\nARGUMENT x.side CAN ONLY BE 1 OR 3\n\n")**

**}**

**par(xpd = FALSE)**

**x.text <- par("usr")[2]**

**}else{**

**stop("\n\nPROBLEM WITH THE x.side (", x.side ,") OR x.log.scale (", x.log.scale,") ARGUMENTS\n\n")**

**}**

**}else{**

**x.text <- par("usr")[2]**

**}**

**if(y.side == 2 | y.side == 4){**

**par(xpd=FALSE, yaxt="s")**

**if(is.null(y.categ) & y.log.scale == TRUE){**

**if(any(par()$yaxp[1:2] == 0)){**

**if(par()$yaxp[1] == 0){**

**par(yaxp = c(10^-30, par()$yaxp[2:3]))** *# because log10(par()$yaxp[1] == 0) == -Inf*

**}**

**if(par()$yaxp[2] == 0){**

**par(yaxp = c(par()$yaxp[1], 10^-30, par()$yaxp[3]))** *# because log10(par()$yaxp[2] == 0) == -Inf*

**}**

**}**

**axis(side=y.side, at=c(10^par()$usr[3], 10^par()$usr[4]), labels=rep("", 2), lwd=1, lwd.ticks=0)** *# draw the axis line*

**par(tcl = -par()$mgp[2] \* sec.tick.length)** *# length of the ticks are reduced*

**suppressWarnings(rug(10^outer(c((log10(par("yaxp")[1])-1):log10(par("yaxp")[2])), log10(1:10), "+"), ticksize = NA, side = y.side))** *# ticksize = NA to allow the use of par()$tcl value*

**par(tcl = -par()$mgp[2] \* tick.length)** *# back to main tick length*

**axis(side = y.side, at = c(1e-15, 1e-14, 1e-13, 1e-12, 1e-11, 1e-10, 1e-9, 1e-8, 1e-7, 1e-6, 1e-5, 1e-4, 1e-3, 1e-2, 1e-1, 1e0, 1e1, 1e2, 1e3, 1e4, 1e5, 1e6, 1e7, 1e8, 1e9, 1e10), labels = expression(10^-15, 10^-14, 10^-13, 10^-12, 10^-11, 10^-10, 10^-9, 10^-8, 10^-7, 10^-6, 10^-5, 10^-4, 10^-3, 10^-2, 10^-1, 10^0, 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, 10^9, 10^10), lwd = 0, lwd.ticks = 1, cex.axis = y.axis.magnific)**

**y.text <- 10^(par("usr")[4] + (par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3]) \* (1 - par("plt")[4]))**

**mtext(side = y.side, text = y.lab, line = y.dist.legend / 0.2, las = 0, cex = y.label.magnific)**

**}else if(is.null(y.categ) & y.log.scale == FALSE){**

**axis(side=y.side, at=c(par()$usr[3], par()$usr[4]), labels=rep("", 2), lwd=1, lwd.ticks=0)** *# draw the axis line*

**axis(side=y.side, at=round(seq(par()$yaxp[1], par()$yaxp[2], length.out=par()$yaxp[3]+1), 2), cex.axis = y.axis.magnific)**

**mtext(side = y.side, text = y.lab, line = y.dist.legend / 0.2, las = 0, cex = y.label.magnific)**

**if(y.nb.inter.tick > 0){**

**inter.tick.unit <- (par("yaxp")[2] - par("yaxp")[1]) / par("yaxp")[3]**

**par(tcl = -par()$mgp[2] \* sec.tick.length)** *# length of the ticks are reduced*

**suppressWarnings(rug(seq(par("yaxp")[1] - 10 \* inter.tick.unit, par("yaxp")[2] + 10 \* inter.tick.unit, by = inter.tick.unit / (1 + y.nb.inter.tick)), ticksize = NA, side=y.side))** *# ticksize = NA to allow the use of par()$tcl value*

**par(tcl = -par()$mgp[2] \* tick.length)** *# back to main tick length*

**}**

**y.text <- (par("usr")[4] + (par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3]) \* (1 - par("plt")[4]))**

**}else if(( ! is.null(y.categ)) & y.log.scale == FALSE){**

**if(is.null(y.categ.pos)){**

**y.categ.pos <- 1:length(y.categ)**

**}else if(length(y.categ.pos) != length(y.categ)){**

**stop("\n\nPROBLEM: y.categ.pos MUST BE THE SAME LENGTH AS y.categ\n\n")**

**}**

**axis(side = y.side, at = y.categ.pos, labels = rep("", length(y.categ)), lwd=0, lwd.ticks=1)** *# draw the line of the axis*

**par(xpd = TRUE)**

**if(y.side == 2){**

**text(x = x.mid.left.fig.region, y = y.categ.pos, labels = y.categ, srt = text.angle, cex = y.axis.magnific)**

**}else if(y.side == 4){**

**text(x = x.mid.right.fig.region, y = y.categ.pos, labels = y.categ, srt = text.angle, cex = y.axis.magnific)**

**}else{**

**stop("\n\nARGUMENT y.side CAN ONLY BE 2 OR 4\n\n")**

**}**

**par(xpd = FALSE)**

**y.text <- (par("usr")[4] + (par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3]) \* (1 - par("plt")[4]))**

**}else{**

**stop("\n\nPROBLEM WITH THE y.side (", y.side ,") OR y.log.scale (", y.log.scale,") ARGUMENTS\n\n")**

**}**

**}else{**

**y.text <- (par("usr")[4] + (par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3]) \* (1 - par("plt")[4]))**

**}**

**par(xpd=NA)**

**text(x = x.mid.right.fig.region, y = y.text, corner.text, adj=c(1, 1.1), cex = magnific.corner.text)** *# text at the topright corner. Replace x.right.fig.region by x.text if text at the right edge of the plot region*

**if(just.label.add == TRUE & x.side == 0 & x.lab != ""){**

**text(x = x.mid.plot.region, y = y.mid.bottom.fig.region, x.lab, adj=c(0.5, 0.5), cex = x.label.magnific)** *# x label*

**}**

**if(just.label.add == TRUE & y.side == 0 & y.lab != ""){**

**text(x = y.mid.plot.region, y = x.mid.left.fig.region, y.lab, adj=c(0.5, 0.5), cex = y.label.magnific)** *# x label*

**}**

**par(xpd=FALSE)**

**if(par.reset == TRUE){**

**tempo.par <- fun\_open(pdf.disp = FALSE, return.output = TRUE)**

**invisible(dev.off())** *# close the new window*

**if( ! is.null(custom.par)){**

**if( ! names(custom.par) %in% names(tempo.par$ini.par)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": custom.par ARGUMENT SHOULD HAVE THE NAMES OF THE COMPARTMENT LIST COMING FROM THE par() LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**par(custom.par)**

**text <- c(text, "\nGRAPH PARAMETERS SET TO VALUES DEFINED BY custom.par ARGUMENT\n")**

**}else{**

**par(tempo.par$ini.par)**

**text <- c(text, "\nGRAPH PARAMETERS RESET TO par() DEFAULT VALUES\n")**

**}**

**}**

**output <- list(x.mid.left.dev.region = x.mid.left.dev.region, x.left.dev.region = x.left.dev.region, x.mid.right.dev.region = x.mid.right.dev.region, x.right.dev.region = x.right.dev.region, x.mid.left.fig.region = x.mid.left.fig.region, x.left.fig.region = x.left.fig.region, x.mid.right.fig.region = x.mid.right.fig.region, x.right.fig.region = x.right.fig.region, x.left.plot.region = x.left.plot.region, x.right.plot.region = x.right.plot.region, x.mid.plot.region = x.mid.plot.region, y.mid.bottom.dev.region = y.mid.bottom.dev.region, y.bottom.dev.region = y.bottom.dev.region, y.mid.top.dev.region = y.mid.top.dev.region, y.top.dev.region = y.top.dev.region, y.mid.bottom.fig.region = y.mid.bottom.fig.region, y.bottom.fig.region = y.bottom.fig.region, y.mid.top.fig.region = y.mid.top.fig.region, y.top.fig.region = y.top.fig.region, y.top.plot.region = y.top.plot.region, y.bottom.plot.region = y.bottom.plot.region, y.mid.plot.region = y.mid.plot.region, text = text)**

**return(output)**

**}**

######## fun\_close() #### close specific graphic windows

**# Check OK: clear to go Apollo**

**fun\_close <- function(kind = "pdf", return.text = FALSE){**

*# AIM*

*# close only specific graphic windows (devices)*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS:*

*# kind: vector, among c("windows", "quartz", "x11", "X11", "pdf", "bmp", "png", "tiff"), indicating the kind of graphic windows (devices) to close. BEWARE: either "windows", "quartz", "x11" or "X11" means that all the X11 GUI graphics devices will be closed, whatever the OS used*

*# return.text: print text regarding the kind parameter and the devices that were finally closed?*

*# RETURN*

*# text regarding the kind parameter and the devices that were finally closed*

*# EXAMPLES*

*# windows() ; windows() ; pdf() ; dev.list() ; fun\_close(kind = c("pdf", "x11"), return.text = TRUE) ; dev.list()*

*# DEBUGGING*

*# kind = c("windows", "pdf") ; return.text = FALSE # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = kind, options = c("windows", "quartz", "x11", "X11", "pdf", "bmp", "png", "tiff"), fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = return.text, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**text <- paste0("THE REQUIRED KIND OF GRAPHIC DEVICES TO CLOSE ARE ", paste(kind, collapse = " "))**

**if(Sys.info()["sysname"] == "Windows"){** *# Note that .Platform$OS.type() only says "unix" for macOS and Linux and "Windows" for Windows*

**if(any(kind %in% c("windows", "quartz", "x11", "X11"))){**

**tempo <- kind %in% c("windows", "quartz", "x11", "X11")**

**kind[tempo] <- "windows"** *# term are replaced by what is displayed when using a <- dev.list() ; names(a)*

**}**

**}else if(Sys.info()["sysname"] == "Linux"){**

**if(any(kind %in% c("windows", "quartz", "x11", "X11"))){**

**tempo.device <- suppressWarnings(try(X11(), silent = TRUE))[]** *# open a X11 window to try to recover the X11 system used*

**if( ! is.null(tempo.device)){**

**text <- paste0(text, "\nCANNOT CLOSE GUI GRAPHIC DEVICES AS REQUIRED BECAUSE THIS LINUX SYSTEM DOES NOT HAVE IT")**

**}else{**

**tempo <- kind %in% c("windows", "quartz", "x11", "X11")**

**kind[tempo] <- names(dev.list()[length(dev.list())])** *# term are replaced by what is displayed when using a <- dev.list() ; names(a)*

**invisible(dev.off())** *# close the X11 opened by tempo*

**}**

**}**

**}else{** *# for macOS*

**if(any(kind %in% c("windows", "quartz", "x11", "X11"))){**

**tempo <- kind %in% c("windows", "quartz", "x11", "X11")**

**kind[tempo] <- "quartz"** *# term are replaced by what is displayed when using a <- dev.list() ; names(a)*

**}**

**}**

**kind <- unique(kind)**

**if(length(dev.list()) != 0){**

**for(i in length(names(dev.list())):1){**

**if(names(dev.list())[i] %in% kind){**

**text <- paste0(text, "\n", names(dev.list())[i], " DEVICE NUMBER ", dev.list()[i], " HAS BEEN CLOSED")**

**invisible(dev.off(dev.list()[i]))**

**}**

**}**

**}**

**if(return.text == TRUE){**

**return(text)**

**}**

**}**

################ Standard graphics

######## fun\_empty\_graph() #### text to display for empty graphs

****

**# Check OK: clear to go Apollo**

**fun\_empty\_graph <- function(text = NULL, text.size = 1, title = NULL, title.size = 1.5){**

*# AIM*

*# display an empty plot with a text in the middle of the window (for instance to specify that no plot can be drawn)*

*# ARGUMENTS*

*# text: character string of the message to display*

*# text.size: numeric value of the text size*

*# title: character string of the graph title*

*# title.size: numeric value of the title size (in points)*

*# REQUIRED PACKAGES*

*# none*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# RETURN*

*# an empty plot*

*# EXAMPLES*

*# simple example*

*# fun\_empty\_graph(text = "NO GRAPH")*

*# white page*

*# fun\_empty\_graph() # white page*

*# all the arguments*

*# fun\_empty\_graph(text = "NO GRAPH", text.size = 2, title = "GRAPH1", title.size = 1)*

*# DEBUGGING*

*# text = "NO GRAPH" ; title = "GRAPH1" ; text.size = 1*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**if( ! is.null(text)){**

**tempo <- fun\_check(data = text, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = text.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(title)){**

**tempo <- fun\_check(data = title, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = title.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**ini.par <- par(no.readonly = TRUE)** *# to recover the initial graphical parameters if required (reset). BEWARE: this command alone opens a pdf of GUI window if no window already opened. But here, protected with the code because always a tempo window opened*

**par(ann=FALSE, xaxt="n", yaxt="n", mar = rep(1, 4), bty = "n", xpd = NA)**

**plot(1, 1, type = "n")** *# no display with type = "n"*

**x.left.dev.region <- (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / ((par("omd")[2] - par("omd")[1]) \* (par("plt")[2] - par("plt")[1]))) \* par("omd")[1])**

**y.top.dev.region <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par("omd")[4] - par("omd")[3]) \* (par("plt")[4] - par("plt")[3]))) \* (1 - par("omd")[4]))**

**if( ! is.null(text)){**

**text(x = 1, y = 1, labels = text, cex = text.size)**

**}**

**if( ! is.null(title)){**

**text(x = x.left.dev.region, y = y.top.dev.region, labels = title, adj=c(0, 1), cex = title.size)**

**}**

**par(ini.par)**

**}**

################ gg graphics

######## fun\_gg\_palette() #### ggplot2 default color palette



**# Check OK: clear to go Apollo**

**fun\_gg\_palette <- function(n, kind = "std"){**

*# AIM*

*# provide colors used by ggplot2*

*# the interest is to use another single color that is not the red one used by default*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# ARGUMENTS*

*# n: number of groups on the graph*

*# kind: either "std" for standard gg colors, "dark" for darkened gg colors, or "light" for pastel gg colors*

*# REQUIRED PACKAGES*

*# none*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# RETURN*

*# the vector of hexadecimal colors*

*# EXAMPLES*

*# output of the function*

*# fun\_gg\_palette(n = 2)*

*# the ggplot2 palette when asking for 7 different colors*

*# plot(1:7, pch = 16, cex = 5, col = fun\_gg\_palette(n = 7))*

*# selection of the 5th color of the ggplot2 palette made of 7 different colors*

*# plot(1:7, pch = 16, cex = 5, col = fun\_gg\_palette(n = 7)[5])*

*# the ggplot2 palette made of 7 darkened colors*

*# plot(1:7, pch = 16, cex = 5, col = fun\_gg\_palette(n = 7, kind = "dark"))*

*# the ggplot2 palette made of 7 lighten colors*

*# plot(1:7, pch = 16, cex = 5, col = fun\_gg\_palette(n = 7, kind = "light"))*

*# DEBUGGING*

*# n = 0*

*# kind = "std"*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = n, class = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & n == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": n ARGUMENT MUST BE A NON ZERO INTEGER. HERE IT IS: ", paste(n, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**tempo <- fun\_check(data = kind, options = c("std", "dark", "light"), length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**hues = seq(15, 375, length = n + 1)**

**hcl(h = hues, l = if(kind == "std"){65}else if(kind == "dark"){35}else if(kind == "light"){85}, c = 100)[1:n]**

**}**

######## fun\_gg\_just() #### ggplot2 justification of the axis labeling, depending on angle



**# Check OK: clear to go Apollo**

**fun\_gg\_just <- function(angle, axis){**

*# AIM*

*# provide correct justification for axis labeling, depending on the chosen angle*

*# ARGUMENTS*

*# angle: integer value of the text angle for the axis labels. Positive values for counterclockwise rotation: 0 for horizontal, 90 for vertical, 180 for upside down etc. Negative values for clockwise rotation: 0 for horizontal, -90 for vertical, -180 for upside down etc.*

*# axis: which axis for? Either "x" or "y"*

*# REQUIRED PACKAGES*

*# none*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# RETURN*

*# a list containing:*

*# $angle: the submitted angle (value potentially reduced to fit the [-360 ; 360] interval, e.g., 460 -> 100, without impact on the final angle displayed)*

*# $hjust: the horizontal justification*

*# $vjust: the vertical justification*

*# EXAMPLES*

*# fun\_gg\_just(angle = 45, axis = "x")*

*# fun\_gg\_just(angle = (360\*2 + 45), axis = "y")*

*# output <- fun\_gg\_just(angle = 45, axis = "x") ; obs1 <- data.frame(time = 1:20, group = rep(c("CLASS\_1", "CLASS\_2"), times = 10)) ; ggplot2::ggplot() + ggplot2::geom\_bar(data = obs1, mapping = ggplot2::aes(x = group, y = time), stat = "identity") + ggplot2::theme(axis.text.x = ggplot2::element\_text(angle = output$angle, hjust = output$hjust, vjust = output$vjust))*

*# output <- fun\_gg\_just(angle = -45, axis = "y") ; obs1 <- data.frame(time = 1:20, group = rep(c("CLASS\_1", "CLASS\_2"), times = 10)) ; ggplot2::ggplot() + ggplot2::geom\_bar(data = obs1, mapping = ggplot2::aes(x = group, y = time), stat = "identity") + ggplot2::theme(axis.text.y = ggplot2::element\_text(angle = output$angle, hjust = output$hjust, vjust = output$vjust)) + ggplot2::coord\_flip()*

*# output1 <- fun\_gg\_just(angle = 90, axis = "x") ; output2 <- fun\_gg\_just(angle = -45, axis = "y") ; obs1 <- data.frame(time = 1:20, group = rep(c("CLASS\_1", "CLASS\_2"), times = 10)) ; ggplot2::ggplot() + ggplot2::geom\_bar(data = obs1, mapping = ggplot2::aes(x = group, y = time), stat = "identity") + ggplot2::theme(axis.text.x = ggplot2::element\_text(angle = output1$angle, hjust = output1$hjust, vjust = output1$vjust), axis.text.y = ggplot2::element\_text(angle = output2$angle, hjust = output2$hjust, vjust = output2$vjust))*

*# DEBUGGING*

*# angle = 45 ; axis = "y"*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = angle, class = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = axis, options = c("x", "y"), length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

*# to get angle between -360 and 360*

**while(angle > 360){**

**angle <- angle - 360**

**}**

**while(angle < -360){**

**angle <- angle + 360**

**}**

*# end to get angle between -360 and 360*

*# justifications*

**if(axis == "x"){**

**if(angle == -360 | angle == -180 | angle == 0 | angle == 180 | angle == 360){**

**hjust <- 0.5**

**vjust <- 0.5**

**}else if(angle == -270 | angle == 90){**

**hjust <- 1**

**vjust <- 0.5**

**}else if(angle == -90 | angle == 270){**

**hjust <- 0**

**vjust <- 0.5**

**}else if((angle > -360 & angle < -270) | (angle > 0 & angle < 90)){**

**hjust <- 1**

**vjust <- 1**

**}else if((angle > -270 & angle < -180) | (angle > 90 & angle < 180)){**

**hjust <- 1**

**vjust <- 0**

**}else if((angle > -180 & angle < -90) | (angle > 180 & angle < 270)){**

**hjust <- 0**

**vjust <- 0**

**}else if((angle > -90 & angle < 0) | (angle > 270 & angle < 360)){**

**hjust <- 0**

**vjust <- 1**

**}**

**}else if(axis == "y"){**

**if(angle == -270 | angle == -90 | angle == 90 | angle == 270){**

**hjust <- 0.5**

**vjust <- 0.5**

**}else if(angle == -360 | angle == 0 | angle == 360){**

**hjust <- 1**

**vjust <- 0.5**

**}else if(angle == -180 | angle == 180){**

**hjust <- 0**

**vjust <- 0.5**

**}else if((angle > -360 & angle < -270) | (angle > 0 & angle < 90)){**

**hjust <- 1**

**vjust <- 0**

**}else if((angle > -270 & angle < -180) | (angle > 90 & angle < 180)){**

**hjust <- 0**

**vjust <- 0**

**}else if((angle > -180 & angle < -90) | (angle > 180 & angle < 270)){**

**hjust <- 0**

**vjust <- 1**

**}else if((angle > -90 & angle < 0) | (angle > 270 & angle < 360)){**

**hjust <- 1**

**vjust <- 1**

**}**

**}**

*# end justifications*

**output <- list(angle = angle, hjust = hjust, vjust = vjust)**

**return(output)**

**}**

######## fun\_gg\_point\_rast() #### ggplot2 raster scatterplot layer



**# Check OK: clear to go Apollo**

**fun\_gg\_point\_rast <- function(data = NULL, mapping = NULL, stat = "identity", position = "identity", ..., na.rm = FALSE, show.legend = NA, inherit.aes = TRUE, raster.width = NULL, raster.height = NULL, raster.dpi = 300, inactivate = TRUE, path.lib = NULL){**

*# AIM*

*# equivalent to ggplot2::geom\_point() but in raster mode*

*# use it like ggplot2::geom\_point() with the main raster.dpi additional argument*

*# WARNINGS*

*# can be long to generate the plot*

*# use a square plot region. Otherwise, the dots will have ellipsoid shape*

*# solve the transparency problems with some GUI*

*# this function is derived from the geom\_point\_rast() function, created by VPetukhov, and present in the ggrastr package (https://rdrr.io/github/VPetukhov/ggrastr/src/R/geom-point-rast.R). Has been placed here to minimize package dependencies*

*# ARGUMENTS*

*# classical arguments of geom\_point(), shown here https://rdrr.io/github/VPetukhov/ggrastr/man/geom\_point\_rast.html*

*# raster.width : width of the result image (in inches). Default: deterined by the current device parameters*

*# raster.height: height of the result image (in inches). Default: deterined by the current device parameters*

*# raster.dpi: resolution of the result image*

*# inactivate: logical. Inactivate the fun.name argument of the fun\_check() function? If TRUE, the name of the fun\_check() function in error messages coming from this function. Use TRUE if fun\_gg\_point\_rast() is used like this: eval(parse(text = "fun\_gg\_point\_rast"))*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# grid*

*# Cairo*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# RETURN*

*# a raster scatter plot*

*# EXAMPLES*

*# Two pdf in the current directory*

*# set.seed(1) ; data1 = data.frame(x = rnorm(100000), y = rnorm(10000)) ; fun\_open(pdf.name.file = "Raster") ; ggplot2::ggplot() + fun\_gg\_point\_rast(data = data1, mapping = ggplot2::aes(x = x, y = y)) ; fun\_open(pdf.name.file = "Vectorial") ; ggplot2::ggplot() + ggplot2::geom\_point(data = data1, mapping = ggplot2::aes(x = x, y = y)) ; dev.off() ; dev.off()*

*# DEBUGGING*

*#*

*# function name*

**if(all(inactivate == FALSE)){** *# inactivate has to be used here but will be fully checked below*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

**}else if(all(inactivate == TRUE)){**

**function.name <- NULL**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN fun\_gg\_point\_rast(): CODE INCONSISTENCY 1\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**if( ! is.null(data)){**

**tempo <- fun\_check(data = data, class = "data.frame", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(mapping)){**

**tempo <- fun\_check(data = mapping, class = "uneval", typeof = "list", fun.name = function.name) ; eval(ee)** *# aes() is tested*

**}**

*# stat and position not tested because too complicate*

**tempo <- fun\_check(data = na.rm, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = show.legend, class = "vector", mode = "logical", length = 1, na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = inherit.aes, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(raster.width)){**

**tempo <- fun\_check(data = raster.width, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(raster.height)){**

**tempo <- fun\_check(data = raster.height, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = raster.dpi, class = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = inactivate, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

**fun\_pack(req.package = c("grid"), path.lib = path.lib)**

**fun\_pack(req.package = c("Cairo"), path.lib = path.lib)**

*# end package checking*

*# additional functions*

**DrawGeomPointRast <- function(data, panel\_params, coord, na.rm = FALSE, raster.width = NULL, raster.height= NULL, raster.dpi = 300){**

**if (is.null(raster.width)){**

**raster.width <- par('fin')[1]**

**}**

**if (is.null(raster.height)){**

**raster.height <- par('fin')[2]**

**}**

**prev\_dev\_id <- dev.cur()**

**p <- ggplot2::GeomPoint$draw\_panel(data, panel\_params, coord)**

**dev\_id <- Cairo::Cairo(type='raster', width = raster.width\*raster.dpi, height = raster.height\*raster.dpi, dpi = raster.dpi, units = 'px', bg = "transparent")[1]**

**grid::pushViewport(grid::viewport(width = 1, height = 1))**

**grid::grid.points(x = p$x, y = p$y, pch = p$pch, size = p$size,**

**name = p$name, gp = p$gp, vp = p$vp, draw = T)**

**grid::popViewport()**

**cap <- grid::grid.cap()**

**dev.off(dev\_id)**

**dev.set(prev\_dev\_id)**

**grid::rasterGrob(cap, x = 0, y = 0, width = 1, height = 1, default.units = "native", just = c("left","bottom"))**

**}**

*# end additional functions*

*# main code*

**GeomPointRast <- ggplot2::ggproto("GeomPointRast", ggplot2::GeomPoint, draw\_panel = DrawGeomPointRast)**

**ggplot2::layer(**

**data = data,**

**mapping = mapping,**

**stat = stat,**

**geom = GeomPointRast,**

**position = position,**

**show.legend = show.legend,**

**inherit.aes = inherit.aes,**

**params = list(**

**na.rm = na.rm,**

**raster.width = raster.width,**

**raster.height = raster.height,**

**raster.dpi = raster.dpi,**

**...**

**)**

**)**

*# end main code*

**}**

######## fun\_gg\_scatter() #### ggplot2 scatterplot + lines (up to 6 overlays totally)

**# Check OK: clear to go Apollo**

**fun\_gg\_scatter <- function(data1, x, y, categ = NULL, legend.name = NULL, color = NULL, geom = "geom\_point", alpha = 0.5, dot.size = 2, line.size = 0.5, xlim = NULL, xlab = NULL, xlog = "no", x.tick.nb = NULL, x.inter.tick.nb = NULL, x.left.extra.margin = 0.05, x.right.extra.margin = 0.05, ylim = NULL, ylab = NULL, ylog = "no", y.tick.nb = NULL, y.inter.tick.nb = NULL, y.top.extra.margin = 0.05, y.bottom.extra.margin = 0.05, xy.include.zero = FALSE, text.size = 12, title = "", title.text.size = 12, show.legend = TRUE, classic = FALSE, grid = FALSE, raster = FALSE, vectorial.limit = NULL, return = FALSE, plot = TRUE, add = NULL, warn.print = FALSE, path.lib = NULL){**

*# AIM*

*# ggplot2 scatterplot with the possibility to overlay dots from up to 3 different data frames and lines from up to 3 different data frames (up to 6 overlays totally)*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# WARNINGS*

*# rows containing NA in data1[, c(y, categ)] will be removed before processing, with a warning (see below)*

*# ARGUMENTS*

*# data1: a dataframe compatible with ggplot, or a list of data frames*

*# x: character string or list of character string (one compartment for each list compartment of data1) of the data1 column name for x-axis. write NULL for each "geom\_hline" in geom argument*

*# y: character string or list of character string (one compartment for each list compartment of data1) of the data1 column name for y-axis. Write NULL for each "geom\_vline" in geom argument*

*# categ: character string or list of character string (one compartment for each list compartment of data1) of the data1 column name for categories. If categ = NULL, no categories (no legend). Some of the list compartments can be NULL, and other not*

*# legend.name: character string list of character string (one compartment for each list compartment of data1) of the legend title. If legend.name = NULL and categ != NULL, then legend.name <- categ. Some of the list compartments can be NULL, and other not*

*# color: vector of character string or list of character vectors (one compartment for each list compartment of data1) for the colors of categ arguments. If color = NULL, default colors of ggplot2. If non null, it can be either: (1) a single color string (all the dots of the corresponding data1 will have this color, whatever categ NULL or not), (2) if categ non null, a vector of string colors, one for each class of categ (each color will be associated according to the alphabetical order of categ classes), (3) if categ non null, a vector or factor of string colors, like if it was one of the column of data1 data frame (beware: a single color per class of categ and a single class of categ per color must be respected). Integers are also accepted instead of character strings, as long as above rules about length are respected. Integers will be processed by fun\_gg\_palette() using the max integer value among all the integers in color. If color is a list, some of the compartments can be NULL. In that case, a different grey color will be used for each NULL compartment*

*# geom: character string or list of character string (one compartment for each list compartment of data1) for the kind of plot. Either "geom\_point" (scatterplot), "geom\_line" (coordinates plotted then line connection from the lowest to highest coordinates), "geom\_path" (line connection respecting the order in data1), "geom\_hline" (horizontal line) or "geom\_vline" (vertical line). BEWARE: for "geom\_hline" or "geom\_vline", (1) x or y argument must be NULL, respectively, (2) xlim or ylim argument must NOT be NULL, respectively, if only these kind of lines are drawn (if other geom present, then xlim = NULL and ylim = NULL will generate xlim and ylim defined by these other geom, which is not possible with "geom\_hline" or "geom\_vline"), (3) the function will draw n lines for n values in the x argument column name of the data1 data frame. If several colors required, the categ argument must be specified and the corresponding categ column name must exist in the data1 data frame with a different class name for each row*

*# alpha: numeric value (from 0 to 1) of the transparency or list of numeric values (one compartment for each list compartment of data1)*

*# dot.size: numeric value of point size*

*# line.size: numeric value of line size*

*# xlim: 2 numeric values for x-axis range. If NULL, range of x in data1. Order of the 2 values matters (for inverted axis). BEWARE: values of the xlim must be already in the corresponding log if xlog argument is not "no" (see below)*

*# xlab: a character string or expression for x-axis legend. If NULL, x of the first data frame in data1. Warning message if the elements in x are different between data frames in data1*

*# xlog: Either "no" (values in the x argument column of the data1 data frame are not log), "log2" (values in the x argument column of the data1 data frame are log2 transformed) or "log10" (values in the x argument column of the data1 data frame are log10 transformed). BEWARE: do not tranform the data, but just display ticks in a log scale manner. Thus, negative or zero values allowed. BEWARE: not possible to have horizontal bars with a log axis, due to a bug in ggplot2 (see https://github.com/tidyverse/ggplot2/issues/881)*

*# x.tick.nb: approximate number of desired label values on the x-axis (n argument of the the fun\_scale() function)*

*# x.inter.tick.nb: number of desired secondary ticks between main ticks. Not considered if xlog is other than "no". In that case, play with the xlim and x.tick.nb arguments*

*# x.left.extra.margin: single proportion (between 0 and 1) indicating if extra margins must be added to xlim. If different from 0, add the range of the axis \* x.left.extra.margin (e.g., abs(xlim[2] - xlim[1]) \* x.left.extra.margin) to the left of x-axis*

*# x.right.extra.margin: idem as x.left.extra.margin but to the bottom of x-axis*

*# ylim: 2 numeric values for y-axis range. If NULL, range of y in data1. Order of the 2 values matters (for inverted axis). BEWARE: values of the ylim must be already in the corresponding log if ylog argument is not "no" (see below)*

*# ylab: a character string or expression for y-axis legend. If NULL, y of the first data frame in data1. Warning message if the elements in y are different between data frames in data1*

*# ylog: Either "no" (values in the y argument column of the data1 data frame are not log), "log2" (values in the y argument column of the data1 data frame are log2 transformed) or "log10" (values in the y argument column of the data1 data frame are log10 transformed). BEWARE: do not tranform the data, but just display ticks in a log scale manner. Thus, negative or zero values allowed. BEWARE: not possible to have horizontal bars with a log axis, due to a bug in ggplot2 (see https://github.com/tidyverse/ggplot2/issues/881)*

*# y.tick.nb: approximate number of desired label values on the y-axis (n argument of the the fun\_scale() function)*

*# y.inter.tick.nb: number of desired secondary ticks between main ticks. Not considered if ylog is other than "no". In that case, play with the ylim and y.tick.nb arguments*

*# y.top.extra.margin: single proportion (between 0 and 1) indicating if extra margins must be added to ylim. If different from 0, add the range of the axis \* y.top.extra.margin (e.g., abs(ylim[2] - ylim[1]) \* y.top.extra.margin) to the top of y-axis*

*# xy.include.zero: logical. Does xlim and ylim range include 0? Ok even if xlog = TRUE or ylog = TRUE because xlim and ylim must already be log transformed values*

*# text.size: numeric value of the size of the (1) axis numbers and axis legends and (2) texts in the graphic legend*

*# title: character string of the graph title*

*# title.text.size: numeric value of the title size (in points)*

*# show.legend: logical. Show legend? Not considered if categ argument is NULL, because this already generate no legend*

*# classic: logical. Use the classic theme (article like)?*

*# grid: logical. Draw horizontal and vertical lines in the background to better read the values? Not considered if classic = FALSE*

*# raster: logical. Dots in raster mode? If FALSE, dots from each geom\_point from geom argument are in vectorial mode (bigger pdf and long to display if millions of dots). If TRUE, dots from each geom\_point from geom argument are in matricial mode (smaller pdf and easy display if millions of dots, but long to generate the layer). If TRUE, the plot region will be square to avoid a bug in fun\_gg\_point\_rast(). If TRUE, solve the transparency problem with some GUI. Overriden by vectorial.limit if non NULL*

*# vectorial.limit: positive integer value indicating the limit of the dot number above which geom\_point from geom argument switch from vectorial mode to raster mode (see the raster argument). If any layer is raster, then the region plot will be square to avoid a bug in fun\_gg\_point\_rast(). Inactive the raster argument if non NULL*

*# return: logical. Return the graph info?*

*# plot: logical. Plot the graphic? If FALSE and return argument is TRUE, graphical parameters and associated warnings are provided without plotting*

*# add: character string allowing to add more ggplot2 features (dots, lines, themes, etc.). BEWARE: (1) must start with "+" just after the simple or double opening quote (no space, end of line, carriage return, etc., allowed), (2) must finish with ")" just before the simple or double closing quote (no space, end of line, carriage return, etc., allowed) and (3) each function must be preceded by "ggplot2::" (for instance: "ggplot2::coord\_flip()). If the character string contains the "ggplot2::theme" string, then internal ggplot2 theme() and theme\_classic() functions will be inactivated to be reused by add. BEWARE: handle this argument with caution since added functions can create conflicts with the preexisting internal ggplot2 functions*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# if raster plots are drawn (see the raster and vectorial.limit arguments):*

*# Cairo*

*# grid*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_gg\_palette()*

*# fun\_gg\_point\_rast()*

*# fun\_pack()*

*# fun\_check()*

*# RETURN*

*# a scatter plot is plot argument is TRUE*

*# a list of the graph info if return argument is TRUE:*

*# $data: the graphic info coordinates*

*# $removed.row.nb: a list of the removed rows numbers in data frames (because of NA). NULL if no row removed*

*# $removed.rows: a list of the removed rows in data frames (because of NA). NULL if no row removed*

*# $axes: the x-axis and y-axis info*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*#### NICE REPRESENTATION*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 10, 3), time = rnorm(1000, 10, 3), group1 = rep(c("A1", "A2"), 500)) ; obs2 <-data.frame(km = rnorm(1000, 15, 3), time = rnorm(1000, 15, 3), group2 = rep(c("G1", "G2"), 500)) ; set.seed(NULL) ; obs1$L1$km[2:3] <- NA ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = NULL, color = list(L1 = 4:5, L2 = 7:8), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), dot.size = 3, line.size = 0.5, xlim = c(1, 25), xlab = "KM", xlog = "no", x.tick.nb = 10, x.inter.tick.nb = 1, x.left.extra.margin = 0, x.right.extra.margin = 0, ylim = c(1, 25), ylab = expression(paste("TIME (", 10^-20, " s)")), ylog = "log10", y.tick.nb = 5, y.top.extra.margin = 0, y.bottom.extra.margin = 0, xy.include.zero = TRUE, classic = TRUE)*

*#### SINGLE GEOMETRIC LAYER*

*# simple example (1) of scatter plot using the classical writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time")*

*# simple example (2) of scatter plot, identical to (1) but using the list writting. Here, a list of one compartment, systematically named L1, is provided to the data1, x, y, categ, geom and alpha. Contrary to example (1), the geom and alpha argument have to be included because the default value are not lists (if data1 is a list, all the x, y, categ, legend.name, color, geom and alpha must also be list if non NULL)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 0.5))*

*# color of dots. Example (1) using the classical writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", color = "blue")*

*# color of dots. Example (2) using the list writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), color = list(L1 = "blue"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 1))*

*# From here, classical writting is use for single element in data1 and list writting otherwise*

*# color of dots. Example (3) when dots are in different categories. Note that categ argument controls the legend display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group")*

*# color of dots. Example (4) when dots are in different categories. A single color mentionned is applied to all the dots*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = "coral")*

*# color of dots. Example (5) when dots are in different categories. Numbers can be used if ggplot colors are desired*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = 2)*

*# color of dots. Example (6) when dots are in different categories, with one color per category (try also color = 2:1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = c("coral", "green"))*

*# color of dots. Example (7) when dots are in different categories, with colors as a data frame column. BEWARE: one color per category must be respected (try also numbers)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B"), col = rep(c("coral", "green"), each = 3)) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = obs1$col)*

*# color of dots. Example (8) when dots are in different categories, with colors as a data frame column. Easiest way (ggplot colors)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = as.numeric(obs1$group))*

*# legend name*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", legend.name = "CLASSES")*

*# different geom features. Example (1) with geom\_line kind of lines*

*# obs1 <- data.frame(km = c(1, 3, 2, 6, 4, 5), time = c(1, 3, 2, 6, 4, 5)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", geom = "geom\_line", categ = "group")*

*# different geom features. Example (2) with geom\_path kind of lines (see the difference with (1))*

*# obs1 <- data.frame(km = c(1, 3, 2, 6, 4, 5), time = c(1, 3, 2, 6, 4, 5)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", geom = "geom\_path", categ = "group")*

*# different geom features. Example (3) with geom\_hline kind of lines. Fake\_y y-axis name by default because y argument must be NULL (see ylab argument below to change this)*

*# obs1 <- data.frame(km = 1:2, time = (1:2)^2, group = c("A", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = NULL, y = "km", geom = "geom\_hline", categ = "group", xlim = c(1,10))*

*# different geom features. Example (4) with geom\_vline kind of lines. Fake\_y y-axis name by default because y argument must be NULL (see ylab argument below to change this)*

*# obs1 <- data.frame(km = 1:2, time = (1:2)^2, group = c("A", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = NULL, geom = "geom\_vline", categ = "group", ylim = c(1,10))*

*#### MULTI GEOMETRIC LAYERS*

*# Note that in subsequent examples, names of list compartments are systematically referred to as L1, L2, etc., to show the correspondence between the arguments data1, x, y, categ, etc.*

*# single layer (as examples above)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 0.5))*

*# simple example of two layers*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# color of dots. Example (1)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (2) of the legend display. The categ argument must be supplied. Make a fake categorical colum in the data frame if necessary (as in this example). The categ argument triggers the legend display. The legend.name argument is used to remove the legend title of each layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = "GROUP1") ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = "GROUP2") ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = list(L1 = NULL, L2 = NULL), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (3) when dots are in different categories (default colors)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# color of dots. Example (3) when dots are in different categories. A single color mentionned per layer is applied to all the dots of the layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (5) when dots are in different categories, with one color per category in each layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = c("coral", "blue"), L2 = c("green", "black")))*

*# color of dots. Example (4) when dots are in different categories. Numbers can be used if ggplot colors are desired*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = 1:2, L2 = c(4, 7)))*

*# color of dots. Example (7) when dots are in different categories, with colors as a data frame column. BEWARE: one color per category must be respected (try also numbers). BEWARE: in color argument, if the column of the data frame does not exist, color can be still displayed (L2 = obs2$notgood is equivalent to L2 = NULL). Such situation is reported in the warning messages (see below)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500), col1 = rep(c("coral", "blue"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500), col2 = rep(c("green", "black"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = obs1$col1, L2 = obs2$col2))*

*# color of dots. Example (8) when dots are in different categories, with colors as a data frame column. Easiest way is not recommended with mutiple layers*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500), col1 = rep(c("coral", "blue"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500), col2 = rep(c("green", "black"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = as.numeric(obs1$group1), L2 = as.numeric(obs2$group2)))*

*# legend name*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), legend.name = list(L1 = "CLASS A", L2 = "CLASS G"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# different geom features. Example (1) with 5 layers. Note that order in data1 defines the overlay order (from below to above) and the order in the legend (from top to bottom)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; obs3 <- data.frame(time = c(29, 31), group3 = c("HORIZ.THRESHOLD.1", "HORIZ.THRESHOLD.2")) ; obs4 <- data.frame(km = 26, group4 = "VERTIC.THRESHOLD") ; obs5 <- data.frame(km = seq(1, 100, 0.1), time = 7\*seq(1, 100, 0.1)^0.5, group5 = "FUNCTION") ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2, L3 = obs3, L4 = obs4, L5 = obs5), x = list(L1 = "km", L2 = "km", L3 = NULL, L4 = "km", L5 = "km"), y = list(L1 = "time", L2 = "time", L3 = "time", L4 = NULL, L5 = "time"), categ = list(L1 = "group1", L2 = "group2", L3 = "group3", L4 = "group4", L5 = "group5"), geom = list(L1 = "geom\_point", L2 = "geom\_point", L3 = "geom\_hline", L4 = "geom\_vline", L5 = "geom\_line"), alpha = list(L1 = 0.5, L2 = 0.5, L3 = 0.5, L4 = 0.5, L5 = 0.5), xlim = c(10, 40), ylim = c(10, 40), classic = TRUE, line.size = 0.75)*

*# layer transparency. One transparency defined by layer (from 0 invisible to 1 opaque). Note that for lines, transparency in not applied in the legend to prevent a ggplot2 bug (https://github.com/tidyverse/ggplot2/issues/2452)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 1, L2 = 0.1))*

*# other different example of mutiple geom features are shown in the fun\_segmentation function*

*#### OTHER GRAPHIC ARGUMENTS*

*# dot size (line.size argument controls size of lines)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", dot.size = 5)*

*# axis management: examples are shown for x-axis but are identical for y-axis*

*# x-axis limits. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlim = c(-1, 25))*

*# x-axis limits. Example (2) showing that order matters in ylim argument*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlim = c(25, -1))*

*# log scale. Example (1). BEWARE: x column must be log, otherwise incoherent scale (see below warning message with the return argument)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10")*

*# log scale. Example (2). BEWARE: values of the xlim must be in the corresponding log*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", xlim = c(1, 10))*

*# tick number. Example (1). Note that the final number shown is approximate*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.tick.nb = 6)*

*# tick number. Example (2) using a log2 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log2", x.tick.nb = 6)*

*# tick number. Example (3) using a log10 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", x.tick.nb = 6)*

*# tick number. Example (4) using a log10 scale: the reverse x-axis correctly deal with log10 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", xlim = c(7, 2))*

*# secondary tick number. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.inter.tick.nb = 4)*

*# secondary ticks. Example (2) not for log2 and log10 scales (see below warning message with the return argument)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", x.inter.tick.nb = 4)*

*# extra margins. To avoid dot cuts*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.left.extra.margin = 0.25, x.right.extra.margin = 0.25)*

*# include zero in both the x-axis and y-xis*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xy.include.zero = TRUE)*

*# graph title, text size and legend display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", text.size = 8, title = "GRAPH1", title.text.size = 16, show.legend = TRUE)*

*# raster display. This switchs from vectorial mode to raster mode. The display can takes some time, but this is easier to export and handle than vectorial display*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(100000, 22, 3), time = rnorm(100000, 22, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", raster = TRUE)*

*# classic representation (use grid = TRUE to display the background lines of the y axis ticks)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", classic = TRUE, grid = FALSE)*

*# graphic info. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", return = TRUE)*

*# graphic info. Example (2) of assignation and warning message display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; output <- fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", return = TRUE) ; cat(output$warnings)*

*# add ggplot2 functions*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", add = "+ggplot2::theme\_classic()")*

*# all the arguments*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 10, 3), time = rnorm(1000, 10, 3), group1 = rep(c("A1", "A2"), 500)) ; obs2 <-data.frame(km = rnorm(1000, 15, 3), time = rnorm(1000, 15, 3), group2 = rep(c("G1", "G2"), 500)) ; set.seed(NULL) ; obs1$L1$km[2:3] <- NA ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = NULL, color = list(L1 = 4:5, L2 = 7:8), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), dot.size = 3, line.size = 0.5, xlim = c(1, 25), xlab = "KM", xlog = "no", x.tick.nb = 10, x.inter.tick.nb = 1, x.left.extra.margin = 0, x.right.extra.margin = 0, ylim = c(1, 25), ylab = "TIME (s)", ylog = "log10", y.tick.nb = 5, y.inter.tick.nb = NULL, y.top.extra.margin = 0, y.bottom.extra.margin = 0, xy.include.zero = TRUE, text.size = 12, title = "", title.text.size = 8, show.legend = TRUE, classic = FALSE, grid = FALSE, raster = FALSE, vectorial.limit = NULL, return = FALSE, plot = TRUE, add = NULL, warn.print = TRUE, path.lib = NULL)*

*# DEBUGGING*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 10, 3), time = rnorm(1000, 10, 3), group1 = rep(c("A1", "A2"), 500)) ; obs2 <-data.frame(km = rnorm(1000, 15, 3), time = rnorm(1000, 15, 3), group2 = rep(c("G1", "G2"), 500)) ; set.seed(NULL) ; obs1$L1$km[2:3] <- NA ; data1 = list(L1 = obs1, L2 = obs2) ; x = list(L1 = "km", L2 = "km") ; y = list(L1 = "time", L2 = "time") ; categ = list(L1 = "group1", L2 = "group2") ; legend.name = NULL ; color = list(L1 = 4:5, L2 = 7:8) ; geom = list(L1 = "geom\_point", L2 = "geom\_point") ; alpha = list(L1 = 0.5, L2 = 0.5) ; dot.size = 3 ; line.size = 0.5 ; xlim = c(25, 0) ; xlab = "KM" ; xlog = "no" ; x.tick.nb = 10 ; x.inter.tick.nb = 1 ; x.left.extra.margin = 0 ; x.right.extra.margin = 0 ; ylim = c(1, 25) ; ylab = "TIME (s)" ; ylog = "log2" ; y.tick.nb = 5 ; y.inter.tick.nb = 2 ; y.top.extra.margin = 0 ; y.bottom.extra.margin = 0 ; xy.include.zero = TRUE ; text.size = 12 ; title = "" ; title.text.size = 8 ; show.legend = TRUE ; classic = FALSE ; grid = FALSE ; raster = FALSE ; vectorial.limit = NULL ; return = FALSE ; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# data1 <- list(L1 = data.frame(a = 1:6, b = (1:6)^2, group = c("A", "A", "A", "B", "B", "B")), L2 = data.frame(a = (1:6)\*2, b = ((1:6)^2)\*2, group = c("A1", "A1", "A1", "B1", "B1", "B1")), L3 = data.frame(a = (1:6)\*3, b = ((1:6)^2)\*3, group3 = c("A4", "A5", "A6", "A7", "B4", "B5"))) ; data1$L1$a[3] <- NA ; data1$L1$group[5] <- NA ; data1$L3$group3[4] <- NA ; x = list(L1 = names(data1$L1)[1], L2 = names(data1$L2)[1], L3 = NULL) ; y = list(L1 = names(data1$L1)[2], L2 = names(data1$L2)[2], L3 = "a") ; categ = list(L1 = "group", L2 = NULL, L3 = NULL) ; legend.name = NULL ; color = NULL ; geom = list(L1 = "geom\_point", L2 = "geom\_point", L3 = "geom\_hline") ; alpha = list(L1 = 0.5, L2 = 0.5, L3 = 0.5) ; dot.size = 1 ; line.size = 0.5 ; xlim = c(14, 4) ; xlab = NULL ; xlog = "log10" ; x.tick.nb = 10 ; x.inter.tick.nb = 4 ; x.left.extra.margin = 0 ; x.right.extra.margin = 0 ; ylim = c(60, 5) ; ylab = NULL ; ylog = "log10" ; y.tick.nb = 10 ; y.inter.tick.nb = 2 ; y.top.extra.margin = 0 ; y.bottom.extra.margin = 0 ; xy.include.zero = FALSE ; text.size = 12 ; title = "" ; title.text.size = 8 ; show.legend = TRUE ; classic = FALSE ; grid = FALSE ; raster = FALSE ; vectorial.limit = NULL ; return = FALSE ; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# data1 <- data.frame(km = 1:2, time = (1:2)^2, group = c("A", "B")) ; data1 ; x = NULL; y = "km"; categ = "group"; legend.name = NULL ; color = NULL ; geom = "geom\_hline"; alpha = 0.5 ; dot.size = 1 ; line.size = 0.5 ; xlim = c(1,10) ; xlab = NULL ; xlog = "log10" ; x.tick.nb = 10 ; x.inter.tick.nb = 4 ; x.left.extra.margin = 0 ; x.right.extra.margin = 0 ; ylim = NULL ; ylab = expression(paste("TIME (", 10^-20, " s)")) ; ylog = "log10" ; y.tick.nb = 10 ; y.inter.tick.nb = 2 ; y.top.extra.margin = 0 ; y.bottom.extra.margin = 0 ; xy.include.zero = FALSE ; text.size = 12 ; title = "" ; title.text.size = 8 ; show.legend = TRUE ; classic = FALSE ; grid = FALSE ; raster = FALSE ; vectorial.limit = NULL ; return = FALSE ; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_gg\_palette", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_palette() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_point\_rast", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_point\_rast() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# reserved words to avoid bugs (used in this function)*

**reserved.words <- c("fake\_x", "fake\_y", "fake\_categ", "color")**

*# end reserved words to avoid bugs (used in this function)*

*# check list lengths (and names of data1 compartments if non name present)*

**warning <- NULL**

**if(all(class(data1) == "list")){**

**if(length(data1) > 6){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data1 ARGUMENT MUST BE A LIST OF 6 DATA FRAMES MAXIMUM (6 OVERLAYS MAX)\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(is.null(names(data1))){**

**names(data1) <- paste0("L", 1:length(data1))**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL NAME COMPARTMENT OF data1 LIST -> NAMES RESPECTIVELY ATTRIBUTED TO EACH COMPARTMENT:\n", paste(names(data1), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if( ! is.null(x)){**

**if( ! (all(class(x) == "list") & length(data1) == length(x))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": x ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}else{**

**x <- vector("list", length(data1))**

**}**

**if( ! is.null(y)){**

**if( ! (all(class(y) == "list") & length(data1) == length(y))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}else{**

**y <- vector("list", length(data1))**

**}**

**if( ! is.null(categ)){**

**if( ! (all(class(categ) == "list") & length(data1) == length(categ))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(legend.name)){**

**if( ! (all(class(legend.name) == "list") & length(data1) == length(legend.name))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": legend.name ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! is.null(color)){**

**if( ! (all(class(color) == "list") & length(data1) == length(color))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": color ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if( ! (all(class(geom) == "list") & length(data1) == length(geom))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": geom ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! (all(class(alpha) == "list") & length(data1) == length(alpha))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": alpha ARGUMENT MUST BE A LIST OF SAME LENGTH AS data1 IF data1 IS A LIST\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# end check list lengths (and names of data1 compartments if non name present)*

*# conversion into lists*

**if(all(is.data.frame(data1))){**

**data1 <- list(L1 = data1)**

**if(all(class(x) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": x ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**x <- list(L1 = x)**

**}**

**if(all(class(y) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**y <- list(L1 = y)**

**}**

**if( ! is.null(categ)){**

**if(all(class(categ) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**categ <- list(L1 = categ)**

**}**

**}**

**if( ! is.null(legend.name)){**

**if(all(class(legend.name) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": legend.name ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**legend.name <- list(L1 = legend.name)**

**}**

**}**

**if( ! is.null(color)){**

**if(all(class(color) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": color ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**color <- list(L1 = color)**

**}**

**}**

**if(all(class(geom) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": geom ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**geom <- list(L1 = geom)**

**}**

**if(all(class(alpha) == "list")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": alpha ARGUMENT CANNOT BE A LIST IF data1 IS A DATA FRAME\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**alpha <- list(L1 = alpha)**

**}**

**}**

*# end conversion into lists*

*# legend name filling*

**if(is.null(legend.name) & ! is.null(categ)){**

**legend.name <- categ**

**}else if(is.null(legend.name) & is.null(categ)){**

**legend.name <- vector("list", length(data1))** *# null list*

**}**

*# end legend name filling*

*# ini categ for legend display*

**fin.lg.disp <- vector("list", 6)** *# will be used at the end to display or not legends*

**fin.lg.disp[] <- FALSE**

**legend.disp <- vector("list", length(data1))**

**if(is.null(categ) | show.legend == FALSE){**

**legend.disp[] <- FALSE**

**}else{**

**for(i2 in 1:length(data1)){**

**if(is.null(categ[[i2]])){**

**legend.disp[[i2]] <- FALSE**

**}else{**

**legend.disp[[i2]] <- TRUE**

**}**

**}**

**}**

*# end ini categ for legend display*

*# integer colors into gg\_palette*

**tempo.check.color <- NULL**

**for(i1 in 1:length(data1)){**

**if(any(is.na(color[[i1]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ": color ARGUMENT CANNOT CONTAIN NA\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**tempo.check.color <- c(tempo.check.color, fun\_check(data = color[[i1]], data.name = ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), class = "integer", double.as.integer.allowed = TRUE, na.contain = TRUE, fun.name = function.name, print = FALSE)$problem)**

**}**

**tempo.check.color <- ! tempo.check.color** *# invert TRUE and FALSE because if integer, then problem = FALSE*

**if(any(tempo.check.color == TRUE)){** *# convert integers into colors*

**tempo.integer <- unlist(color[tempo.check.color])**

**tempo.color <- fun\_gg\_palette(max(tempo.integer, na.rm = TRUE))**

**for(i1 in 1:length(data1)){**

**if(tempo.check.color[i1] == TRUE){**

**color[[i1]] <-tempo.color[color[[i1]]]**

**}**

**}**

**}**

*# end integer colors into gg\_palette*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**compart.null.color <- 0** *# will be used to attribute a color when color is non NULL but a compartment of color is NULL*

**data1.ini <- data1** *# to report NA removal*

**removed.row.nb <- vector("list", length = length(data1))** *# to report NA removal*

**removed.rows <- vector("list", length = length(data1))** *# to report NA removal*

**for(i1 in 1:length(data1)){**

**tempo <- fun\_check(data = data1[[i1]], data.name = ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), class = "data.frame", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

*# reserved word checking*

**if(any(names(data1[[i1]]) %in% reserved.words)){** *# I do not use fun\_name\_change() because cannot control y before creating "fake\_y". But ok because reserved are not that common*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": COLUMN NAMES OF ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), " ARGUMENT CANNOT BE ONE OF THESE WORDS\n", paste(reserved.words, collapse = " "), "\nTHESE ARE RESERVED FOR THE ", function.name, " FUNCTION\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

*# end reserved word checking*

*# check of geom now because required for y argument*

**tempo <- fun\_check(data = geom[[i1]], data.name = ifelse(length(geom) == 1, "geom", paste0("geom NUMBER ", i1)), options = c("geom\_point", "geom\_line", "geom\_path", "geom\_hline", "geom\_vline"), length = 1, fun.name = function.name) ; eval(ee)**

*# end check of geom now because required for y argument*

**if(is.null(x[[i1]])){**

**if(all(geom[[i1]] != "geom\_hline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ": x ARGUMENT CANNOT BE NULL EXCEPT IF ", ifelse(length(geom) == 1, "x", paste0("geom NUMBER ", i1)), " ARGUMENT IS \"geom\_hline\"\nHERE geom ARGUMENT IS: ", paste(geom[[i1]], collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{**

**x[[i1]] <- "fake\_x"**

**data1[[i1]] <- cbind(data1[[i1]], fake\_x = NA)**

**data1[[i1]][, "fake\_x"] <- as.numeric(data1[[i1]][, "fake\_x"])**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL ", ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), " ARGUMENT ASSOCIATED TO ", ifelse(length(geom) == 1, "geom", paste0("geom NUMBER ", i1)), " ARGUMENT ", geom[[i1]], " -> FAKE COLUMN ADDED TO DATA FRAME ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", NAMED \"fake\_x\" FOR FINAL DRAWING")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}else{**

**if(all(geom[[i1]] == "geom\_hline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ": x ARGUMENT MUST BE NULL IF ", ifelse(length(geom) == 1, "geom", paste0("geom NUMBER ", i1)), " ARGUMENT IS \"geom\_hline\"\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = x[[i1]], data.name = ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if(is.null(y[[i1]])){**

**if(all(geom[[i1]] != "geom\_vline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ": y ARGUMENT CANNOT BE NULL EXCEPT IF ", ifelse(length(geom) == 1, "y", paste0("geom NUMBER ", i1)), " ARGUMENT IS \"geom\_vline\"\nHERE geom ARGUMENT IS: ", paste(geom[[i1]], collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{**

**y[[i1]] <- "fake\_y"**

**data1[[i1]] <- cbind(data1[[i1]], fake\_y = NA)**

**data1[[i1]][, "fake\_y"] <- as.numeric(data1[[i1]][, "fake\_y"])**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL ", ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), " ARGUMENT ASSOCIATED TO ", ifelse(length(geom) == 1, "geom", paste0("geom NUMBER ", i1)), " ARGUMENT ", geom[[i1]], " -> FAKE COLUMN ADDED TO DATA FRAME ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", NAMED \"fake\_y\" FOR FINAL DRAWING")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}else{**

**if(all(geom[[i1]] == "geom\_vline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ": y ARGUMENT MUST BE NULL IF ", ifelse(length(geom) == 1, "geom", paste0("geom NUMBER ", i1)), " ARGUMENT IS \"geom\_vline\"\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = y[[i1]], data.name = ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if( ! (x[[i1]] %in% names(data1[[i1]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), " ARGUMENT MUST BE A COLUMN NAME OF ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! (y[[i1]] %in% names(data1[[i1]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), " ARGUMENT MUST BE A COLUMN NAME OF ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

*# na detection and removal (done now to be sure of the correct length of categ)*

**if(x[[i1]] == "fake\_x" & y[[i1]] == "fake\_y"){** *# because the code cannot accept to be both "fake\_x" and "fake\_y" at the same time*

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\nTHE CODE CANNOT ACCEPT x AND y TO BE \"fake\_x\" AND \"fake\_y\" IN THE SAME DATA FRAME ", i1, " \n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(is.na(data1[[i1]][, c(if(x[[i1]] == "fake\_x"){NULL}else{x[[i1]]}, if(y[[i1]] == "fake\_y"){NULL}else{y[[i1]]})]))){**

**tempo.removed.row.nb <- unlist(lapply(lapply(c(data1[[i1]][c(if(x[[i1]] == "fake\_x"){NULL}else{x[[i1]]}, if(y[[i1]] == "fake\_y"){NULL}else{y[[i1]]})]), FUN = is.na), FUN = which))**

**removed.row.nb[[i1]] <- c(removed.row.nb[[i1]], tempo.removed.row.nb)**

*# report of removed rows will be performed at the very end*

**data1[[i1]] <- data1[[i1]][-tempo.removed.row.nb, ]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NA DETECTED IN COLUMN ", if(x[[i1]] == "fake\_x"){""}else{ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1))}, if(x[[i1]] != "fake\_x" & y[[i1]] != "fake\_y"){" AND "}, if(y[[i1]] == "fake\_y"){""}else{ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1))}, " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ". CORRESPONDING ROWS HAVE BEEN REMOVED (SEE $removed.row.nb AND $removed.rows)")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end na detection and removal (done now to be sure of the correct length of categ)*

**tempo <- fun\_check(data = data1[[i1]][, x[[i1]]], data.name = ifelse(length(x) == 1, "x OF data1", paste0("x NUMBER ", i1, " OF data1 NUMBER ", i1)), class = "vector", mode = "numeric", na.contain = ifelse(x[[i1]] == "fake\_x", TRUE, FALSE), fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = data1[[i1]][, y[[i1]]], data.name = ifelse(length(y) == 1, "y OF data1", paste0("y NUMBER ", i1, " OF data1 NUMBER ", i1)), class = "vector", mode = "numeric", na.contain = ifelse(y[[i1]] == "fake\_y", TRUE, FALSE), fun.name = function.name) ; eval(ee)**

**if(( ! is.null(categ)) & ( ! is.null(categ[[i1]]))){** *# if categ[[i1]] = NULL, fake\_categ will be created later on*

**tempo <- fun\_check(data = categ[[i1]], data.name = ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)),, class = "vector", mode = "character", length = 1, fun.name = function.name)**

**if( ! (categ[[i1]] %in% names(data1[[i1]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " ARGUMENT MUST BE A COLUMN NAME OF ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

*# na detection and removal (done now to be sure of the correct length of categ)*

**if(any(is.na(data1[[i1]][, categ[[i1]]]))){**

**tempo.removed.row.nb <- unlist(lapply(lapply(c(data1[[i1]][categ[[i1]]]), FUN = is.na), FUN = which))**

**removed.row.nb[[i1]] <- c(removed.row.nb[[i1]], tempo.removed.row.nb)**

*# report of removed rows will be performed at the very end*

**data1[[i1]] <- data1[[i1]][-tempo.removed.row.nb, ]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", THE CATEGORY COLUMN:\n", paste(categ[[i1]], collapse = " "), "\nCONTAINS NA")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end na detection and removal (done now to be sure of the correct length of categ)*

**tempo1 <- fun\_check(data = data1[[i1]][, categ[[i1]]], data.name = ifelse(length(categ) == 1, "categ OF data1", paste0("categ NUMBER ", i1, " OF data1 NUMBER ", i1)), class = "vector", mode = "character", na.contain = FALSE, fun.name = function.name, print = FALSE)**

**tempo2 <- fun\_check(data = data1[[i1]][, categ[[i1]]], data.name = ifelse(length(categ) == 1, "categ OF data1", paste0("categ NUMBER ", i1, " OF data1 NUMBER ", i1)), class = "factor", na.contain = FALSE, fun.name = function.name, print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(categ) == 1, "categ OF data1", paste0("categ NUMBER ", i1, " OF data1 NUMBER ", i1)), " MUST BE A FACTOR OR CHARACTER VECTOR\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo1$problem == FALSE){**

**data1[[i1]][, categ[[i1]]] <- factor(data1[[i1]][, categ[[i1]]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", THE CHARACTER COLUMN HAS BEEN CONVERTED TO FACTOR")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if(geom[[i1]] == "geom\_vline" | geom[[i1]] == "geom\_hline"){**

**if(length(unique(data1[[i1]][, categ[[i1]]])) != nrow(data1[[i1]])){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(geom) == 1, "geom OF data1", paste0("geom NUMBER ", i1, " OF data1 NUMBER ", i1)), " ARGUMENT IS ", geom[[i1]], ", MEANING THAT ", ifelse(length(categ) == 1, "categ OF data1", paste0("categ NUMBER ", i1, " OF data1 NUMBER ", i1)), " MUST HAVE A DIFFERENT CLASS PER LINE OF data1 (ONE x VALUE PER CLASS)\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}else if(( ! is.null(categ)) & is.null(categ[[i1]])){** *# if categ[[i1]] = NULL, fake\_categ will be created. BEWARE: is.null(categ[[i1]]) means no legend display (see above), because categ has not been precised. This also means a single color for data1[[i1]]*

**if(length(color[[i1]]) > 1){** *# 0 means is.null(color[[i1]]) and 1 is ok -> single color for data1[[i1]]*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " ARGUMENT BUT CORRESPONDING COLORS IN ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " HAS LENGTH OVER 1\n", paste(color[[i1]], collapse = " "), "\nWHICH IS NOT COMPATIBLE WITH NULL CATEG -> COLOR RESET TO A SINGLE COLOR")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**color[[i1]] <- NULL** *# will provide a single color below*

**}**

**categ[[i1]] <- "fake\_categ"**

**data1[[i1]] <- cbind(data1[[i1]], fake\_categ = "")**

*# inactivated because give a different color to different "Line\_" categ while a single color for all the data1[[i1]] required. Thus, put back after the color management*

*# if(geom[[i1]] == "geom\_hline" | geom[[i1]] == "geom\_vline"){*

*# data1[[i1]][, "fake\_categ"] <- paste0("Line\_", 1:nrow(data1[[i1]]))*

*# }else{*

**data1[[i1]][, "fake\_categ"] <- data1[[i1]][, "fake\_categ"]** *# as.numeric("") create a vector of NA but class numeric*

*# }*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " ARGUMENT -> FAKE COLUMN ADDED TO DATA FRAME ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", NAMED \"fake\_categ\" FOR FINAL DRAWING")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if( ! is.null(legend.name[[i1]])){**

**tempo <- fun\_check(data = legend.name[[i1]], data.name = ifelse(length(legend.name) == 1, "legend.name", paste0("legend.name NUMBER ", i1)),, class = "vector", mode = "character", length = 1, fun.name = function.name)**

**}**

**if( ! is.null(color)){** *# if color is NULL, will be filled later on*

*# check the nature of color*

**if(is.null(color[[i1]])){**

**compart.null.color <- compart.null.color + 1**

**color[[i1]] <- grey(compart.null.color / 8)** *# cannot be more than 7 overlays. Thus 7 different greys. 8/8 is excluded because white dots*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL COLOR IN ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", SINGLE COLOR ", paste(color[[i1]], collapse = " "), " HAS BEEN ATTRIBUTED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**tempo1 <- fun\_check(data = color[[i1]], data.name = ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), class = "vector", mode = "character", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**tempo2 <- fun\_check(data = color[[i1]], data.name = ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), class = "factor", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " MUST BE A FACTOR OR CHARACTER VECTOR OR INTEGER VECTOR\n\n================\n\n")** *# integer possible because dealt above*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if( ! (all(color[[i1]] %in% colors() | grepl(pattern = "^#", color[[i1]])))){** *# check that all strings of low.color start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors(): ", paste(unique(color[[i1]]), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if(any(is.na(color[[i1]]))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", THE COLORS:\n", paste(unique(color[[i1]]), collapse = " "), "\nCONTAINS NA")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end check the nature of color*

*# check the length of color*

**if(is.null(categ) & length(color[[i1]]) != 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST BE A SINGLE COLOR IF categ IS NULL\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if( ! is.null(categ)){**

*# No problem of NA management by ggplot2 because already removed*

**if(categ[[i1]] == "fake\_categ" & length(color[[i1]]) != 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST BE A SINGLE COLOR IF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IS NULL\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(length(color[[i1]]) == length(unique(data1[[i1]][, categ[[i1]]]))){** *# here length(color) is equal to the different number of categ*

**data1[[i1]][, categ[[i1]]] <- factor(data1[[i1]][, categ[[i1]]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", THE FOLLOWING COLORS:\n", paste(color[[i1]], collapse = " "), "\nHAVE BEEN ATTRIBUTED TO THESE CLASSES:\n", paste(levels(factor(data1[[i1]][, categ[[i1]]])), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(length(color[[i1]]) == length(data1[[i1]][, categ[[i1]]])){***# here length(color) is equal to nrow(data1[[i1]]) -> Modif to have length(color) equal to the different number of categ (length(color) == length(levels(data1[[i1]][, categ[[i1]]])))*

**data1[[i1]] <- cbind(data1[[i1]], color = color[[i1]])**

**tempo.check <- unique(data1[[i1]][ , c(categ[[i1]], "color")])**

**if( ! (nrow(data1[[i1]]) == length(color[[i1]]) & nrow(tempo.check) == length(unique(data1[[i1]][ , categ[[i1]]])))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT HAS THE LENGTH OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), " COLUMN VALUES\nBUT IS INCORRECTLY ASSOCIATED TO EACH CLASS OF THIS categ:\n", paste(unique(mapply(FUN = "paste", data1[[i1]][ ,categ[[i1]]], data1[[i1]][ ,"color"])), collapse = "\n"), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{**

**data1[[i1]][, categ[[i1]]] <- factor(data1[[i1]][, categ[[i1]]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**color[[i1]] <- unique(color[[i1]][order(data1[[i1]][, categ[[i1]]])])** *# Modif to have length(color) equal to the different number of categ (length(color) == length(levels(data1[[i1]][, categ[[i1]]])))*

**tempo.warning <- paste0(ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT HAS THE LENGTH OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), " COLUMN VALUES\nCOLORS HAVE BEEN RESPECTIVELY ASSOCIATED TO EACH CLASS OF categ AS:\n", paste(levels(factor(data1[[i1]][, categ[[i1]]])), collapse = " "), "\n", paste(color[[i1]], collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}else if(length(color[[i1]]) == 1){**

**data1[[i1]][, categ[[i1]]] <- factor(data1[[i1]][, categ[[i1]]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**color[[i1]] <- rep(color[[i1]], length(levels(data1[[i1]][, categ[[i1]]])))**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), ", COLOR HAS LENGTH 1 MEANING THAT ALL THE DIFFERENT CLASSES OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), "\n", paste(levels(factor(data1[[i1]][, categ[[i1]]])), collapse = " "), "\nWILL HAVE THE SAME COLOR\n", paste(color[[i1]], collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST BE (1) LENGTH 1, OR (2) THE LENGTH OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), " COLUMN VALUES, OR (3) THE LENGTH OF THE CLASSES IN THIS COLUMN. HERE IT IS COLOR LENGTH ", length(color[[i1]]), " VERSUS CATEG LENGTH ", length(data1[[i1]][, categ[[i1]]]), " AND CATEG CLASS LENGTH ", length(unique(data1[[i1]][, categ[[i1]]])), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}**

**if((geom[[i1]] == "geom\_hline" | geom[[i1]] == "geom\_vline") & ! is.null(categ[[i1]])){** *# add here after the color management, to deal with the different lines to plot inside any data[[i1]]*

**if(categ[[i1]] == "fake\_categ"){**

**data1[[i1]][, "fake\_categ"] <- paste0("Line\_", 1:nrow(data1[[i1]]))**

**}**

**}**

**tempo <- fun\_check(data = alpha[[i1]], data.name = ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if(length(data1) > 1){**

**if(length(unique(unlist(x))) > 1){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE x ARGUMENT DOES NOT CONTAIN IDENTICAL COLUMN NAMES:\n", paste(unlist(x), collapse = " "), "\nX-AXIS OVERLAYING DIFFERENT VARIABLES?")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

**if(length(data1) > 1){**

**if(length(unique(unlist(y))) > 1){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE y ARGUMENT DOES NOT CONTAIN IDENTICAL COLUMN NAMES:\n", paste(unlist(y), collapse = " "), "\nY-AXIS OVERLAYING DIFFERENT VARIABLES?")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

**if(sum(geom %in% "geom\_point") > 3){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": geom ARGUMENT CANNOT HAVE MORE THAN FOUR \"geom\_point\" ELEMENTS\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(length(geom) - sum(geom %in% "geom\_point") > 3){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": geom ARGUMENT CANNOT HAVE MORE THAN THREE LINE ELEMENTS\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = dot.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = line.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**if( ! is.null(xlim)){**

**tempo <- fun\_check(data = xlim, class = "vector", mode = "numeric", length = 2, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & any(xlim %in% c(Inf, -Inf))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": xlim ARGUMENT CANNOT CONTAIN -Inf OR Inf VALUES\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(xlab)){**

**if(all(class(xlab) %in% "expression")){** *# to deal with math symbols*

**tempo <- fun\_check(data = xlab, class = "expression", length = 1, fun.name = function.name) ; eval(ee)**

**}else{**

**tempo <- fun\_check(data = xlab, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**}**

**tempo <- fun\_check(data = xlog, options = c("no", "log2", "log10"), length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & xlog != "no"){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": xlog ARGUMENT SET TO ", xlog, ".\nVALUES FROM THE x ARGUMENT COLUMN OF THE data1 DATA FRAME MUST BE ALREADY ", toupper(xlog), " TRANSFORMED, AS THE xlog ARGUMENT JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**if( ! is.null(xlim)){**

**if(any(xlim <= 0)){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": xlim ARGUMENT CAN SPAN ZERO OR NEGATIVE VALUES IF xlog ARGUMENT IS SET TO ", xlog, " BECAUSE THIS LATTER ARGUMENT DOES NOT TRANSFORM DATA, JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(any( ! is.finite(if(xlog == "log10"){10^xlim}else{2^xlim}))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": xlim ARGUMENT RETURNS INF WITH THE xlog ARGUMENT SET TO ", xlog, "\nAS SCALE COMPUTATION IS ", ifelse(xlog == "log10", 10, 2), "^xlim:\n", paste(ifelse(xlog == "log10", 10, 2)^xlim, collapse = " "), "\nARE YOU SURE THAT xlim ARGUMENT HAS BEEN SPECIFIED WITH VALUES ALREADY IN LOG SCALE?\n", paste(xlim, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}**

**if( ! is.null(x.tick.nb)){**

**tempo <- fun\_check(data = x.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & x.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": x.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(x.inter.tick.nb)){**

**tempo <- fun\_check(data = x.inter.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & x.inter.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": x.inter.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = x.left.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.right.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(ylim)){**

**tempo <- fun\_check(data = ylim, class = "vector", mode = "numeric", length = 2, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & any(ylim %in% c(Inf, -Inf))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ylim ARGUMENT CANNOT CONTAIN -Inf OR Inf VALUES\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(ylab)){**

**if(all(class(ylab) %in% "expression")){** *# to deal with math symbols*

**tempo <- fun\_check(data = ylab, class = "expression", length = 1, fun.name = function.name) ; eval(ee)**

**}else{**

**tempo <- fun\_check(data = ylab, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**}**

**tempo <- fun\_check(data = ylog, options = c("no", "log2", "log10"), length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ylog != "no"){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ylog ARGUMENT SET TO ", ylog, ".\nVALUES FROM THE y ARGUMENT COLUMN OF THE data1 DATA FRAME MUST BE ALREADY ", toupper(ylog), " TRANSFORMED, AS THE ylog ARGUMENT JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**if( ! is.null(ylim)){**

**if(any(ylim <= 0)){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ylim ARGUMENT CAN SPAN ZERO OR NEGATIVE VALUES IF ylog ARGUMENT IS SET TO ", ylog, " BECAUSE THIS LATTER ARGUMENT DOES NOT TRANSFORM DATA, JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(any( ! is.finite(if(ylog == "log10"){10^ylim}else{2^ylim}))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ylim ARGUMENT RETURNS INF WITH THE ylog ARGUMENT SET TO ", ylog, "\nAS SCALE COMPUTATION IS ", ifelse(ylog == "log10", 10, 2), "^ylim:\n", paste(ifelse(ylog == "log10", 10, 2)^ylim, collapse = " "), "\nARE YOU SURE THAT ylim ARGUMENT HAS BEEN SPECIFIED WITH VALUES ALREADY IN LOG SCALE?\n", paste(ylim, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}**

**if( ! is.null(y.tick.nb)){**

**tempo <- fun\_check(data = y.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(y.inter.tick.nb)){**

**tempo <- fun\_check(data = y.inter.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.inter.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y.inter.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = y.top.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.bottom.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = xy.include.zero, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

*# inactivated because xlim and ylim already log transformed*

*# if(tempo$problem == FALSE & ylog == TRUE & xy.include.zero == TRUE){*

*#tempo.warning <- paste0("FROM FUNCTION ", function.name, ": BOTH ylog AND xy.include.zero ARGUMENTS SET TO TRUE -> xy.include.zero ARGUMENT RESET TO FALSE")*

*# warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))*

*# }*

**tempo <- fun\_check(data = text.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title.text.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = show.legend, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = classic, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = grid, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = raster, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(vectorial.limit)){**

**tempo <- fun\_check(data = vectorial.limit, class = "vector", typeof = "integer", neg.values = FALSE, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = return, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = plot, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(add)){**

**tempo <- fun\_check(data = add, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! grepl(pattern = "^\\+", add)){** *# check that the add string start by +*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST START WITH \"+\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = "ggplot2::", add)){** *#*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST CONTAIN \"ggplot2::\" IN FRONT OF EACH GGPLOT2 FUNCTION: ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = ")$", add)){** *# check that the add string finished by )*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST FINISH BY \")\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

*# packages Cairo and grid tested by fun\_gg\_point\_rast()*

*# end package checking*

*# main code*

*# axes management*

**if(is.null(xlim)){**

**if(any(unlist(mapply(FUN = "[[", data1, x, SIMPLIFY = FALSE)) %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE x COLUMN IN data1 CONTAINS -Inf OR Inf VALUES THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**xlim <- suppressWarnings(range(unlist(mapply(FUN = "[[", data1, x, SIMPLIFY = FALSE)), na.rm = TRUE, finite = TRUE))** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only. xlim added here. If NULL, ok if x argument has values*

**if(suppressWarnings(all(xlim %in% c(Inf, -Inf)))){**

**if(all(unlist(geom) == "geom\_hline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " NOT POSSIBLE TO ONLY DRAW geom\_hline KIND OF LINES IF xlim ARGUMENT IS SET TO NULL, SINCE NO X-AXIS DEFINED (", ifelse(length(x) == 1, "x", paste0("x NUMBER ", i1)), " ARGUMENT MUST BE NULL FOR THESE KIND OF LINES)\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " xlim ARGUMENT MADE OF NA, -Inf OR Inf ONLY: ", paste(xlim, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**xlim.order <- order(xlim)** *# to deal with inverse axis*

**# print(xlim.order)**

**xlim <- sort(xlim)**

**xlim[1] <- xlim[1] - abs(xlim[2] - xlim[1]) \* ifelse(diff(xlim.order) > 0, x.right.extra.margin, x.left.extra.margin)** *# diff(xlim.order) > 0 means not inversed axis*

**xlim[2] <- xlim[2] + abs(xlim[2] - xlim[1]) \* ifelse(diff(xlim.order) > 0, x.left.extra.margin, x.right.extra.margin)** *# diff(xlim.order) > 0 means not inversed axis*

**if(xy.include.zero == TRUE){** *# no need to check xlog != "no" because done before*

**xlim <- range(c(xlim, 0), na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**xlim <- xlim[xlim.order]**

**if(any(is.na(xlim))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 3\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(is.null(ylim)){**

**if(any(unlist(mapply(FUN = "[[", data1, y, SIMPLIFY = FALSE)) %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE y COLUMN IN data1 CONTAINS -Inf OR Inf VALUES THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**ylim <- suppressWarnings(range(unlist(mapply(FUN = "[[", data1, y, SIMPLIFY = FALSE)), na.rm = TRUE, finite = TRUE))** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only. ylim added here. If NULL, ok if y argument has values*

**if(suppressWarnings(all(ylim %in% c(Inf, -Inf)))){** *# happen when y is only NULL*

**if(all(unlist(geom) == "geom\_vline")){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " NOT POSSIBLE TO ONLY DRAW geom\_vline KIND OF LINES IF ylim ARGUMENT IS SET TO NULL, SINCE NO Y-AXIS DEFINED (", ifelse(length(y) == 1, "y", paste0("y NUMBER ", i1)), " ARGUMENT MUST BE NULL FOR THESE KIND OF LINES)\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " ylim ARGUMENT MADE OF NA, -Inf OR Inf ONLY: ", paste(ylim, collapse = " "), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

**ylim.order <- order(ylim)** *# to deal with inverse axis*

**ylim <- sort(ylim)**

**ylim[1] <- ylim[1] - abs(ylim[2] - ylim[1]) \* ifelse(diff(ylim.order) > 0, y.bottom.extra.margin, y.top.extra.margin)** *# diff(ylim.order) > 0 means not inversed axis*

**ylim[2] <- ylim[2] + abs(ylim[2] - ylim[1]) \* ifelse(diff(ylim.order) > 0, y.top.extra.margin, y.bottom.extra.margin)** *# diff(ylim.order) > 0 means not inversed axis*

**if(xy.include.zero == TRUE){** *# no need to check ylog != "no" because done before*

**ylim <- range(c(ylim, 0), na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**ylim <- ylim[ylim.order]**

**if(any(is.na(ylim))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 4\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# end axes management*

*# create a fake categ if NULL to deal with legend display*

**if(is.null(categ)){**

**categ <- vector("list", length(data1))**

**categ[] <- "fake\_categ"**

**for(i2 in 1:length(data1)){**

**data1[[i2]] <- cbind(data1[[i2]], fake\_categ = "")**

**if(geom[[i2]] == "geom\_hline" | geom[[i2]] == "geom\_vline"){**

**data1[[i2]][, "fake\_categ"] <- paste0("Line\_", 1:nrow(data1[[i2]]))**

**}**

**}**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL categ ARGUMENT -> FAKE COLUMN ADDED TO EACH DATA FRAME IN data1, NAMED \"fake\_categ\" AND FILLED WITH \"\"")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end create a fake categ if NULL to deal with legend display*

*# vector of color with length as in data1*

**if(is.null(color)){**

**color <- vector("list", length(data1))**

**length.categ.list <- lapply(lapply(mapply(FUN = "[[", data1, categ, SIMPLIFY = FALSE), FUN = unique), FUN = function(x){length(x[ ! is.na(x)])})**

**length.categ.list[sapply(categ, FUN = "==", "fake\_categ")] <- 1** *# when is.null(color), a single color for all the dots or lines of data[[i1]] that contain "fake\_categ" category*

**total.categ.length <- sum(unlist(length.categ.list), na.rm = TRUE)**

**tempo.color <- fun\_gg\_palette(total.categ.length)**

**tempo.count <- 0**

**for(i3 in 1:length(data1)){**

**color[[i3]] <- tempo.color[(1:length.categ.list[[i3]]) + tempo.count]**

**tempo.count <- tempo.count + length.categ.list[[i3]]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL color ARGUMENT -> COLORS RESPECTIVELY ATTRIBUTED TO EACH CLASS OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i3)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i3)), ":\n", paste(unlist(color), collapse = " "), "\n", paste(names(data1), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

*# end vector of color with length as in data1*

*# last check*

**for(i1 in 1:length(data1)){**

**if(categ[[i1]] != "fake\_categ" & length(color[[i1]]) != length(unique(data1[[i1]][, categ[[i1]]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " LAST CHECK: ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST HAVE THE LENGTH OF LEVELS OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), "\nHERE IT IS COLOR LENGTH ", length(color[[i1]]), " VERSUS CATEG LEVELS LENGTH ", length(unique(data1[[i1]][, categ[[i1]]])), "\n\n================\n\n")**

**stop(tempo.cat)**

**}else if(categ[[i1]] == "fake\_categ" & length(color[[i1]]) != 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " LAST CHECK: ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST HAVE LENGTH 1 WHEN ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IS NULL\nHERE IT IS COLOR LENGTH ", length(color[[i1]]), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# end last check*

*# conversion of geom\_hline and geom\_vline*

**for(i1 in 1:length(data1)){**

**if(geom[[i1]] == "geom\_hline" | geom[[i1]] == "geom\_vline"){**

**final.data.frame <- data.frame()**

**for(i3 in 1:nrow(data1[[i1]])){**

**tempo.data.frame <- rbind(data1[[i1]][i3, ], data1[[i1]][i3, ])**

**if(geom[[i1]] == "geom\_hline"){**

**tempo.data.frame[, x[[i1]]] <- xlim**

**}else if(geom[[i1]] == "geom\_vline"){**

**tempo.data.frame[, y[[i1]]] <- ylim**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 5\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**# if(is.null(categ[[i1]])){**

**# data1[, "fake\_categ"] <- paste0("Line\_", i3)**

**# } #I put that up**

**final.data.frame <- rbind(final.data.frame, tempo.data.frame)**

**}**

**data1[[i1]] <- final.data.frame**

**geom[[i1]] <- "geom\_line"**

**if(length(color[[i1]]) == 1){**

**color[[i1]] <- rep(color[[i1]], length(unique(data1[[i1]][ , categ[[i1]]])))**

**}else if(length(color[[i1]]) != length(unique(data1[[i1]][ , categ[[i1]]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " geom\_hline AND geom\_vline CONVERSION TO FIT THE XLIM AND YLIM LIMITS OF THE DATA: ", ifelse(length(color) == 1, "color", paste0("color NUMBER ", i1)), " ARGUMENT MUST HAVE THE LENGTH OF LEVELS OF ", ifelse(length(categ) == 1, "categ", paste0("categ NUMBER ", i1)), " IN ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i1)), "\nHERE IT IS COLOR LENGTH ", length(color[[i1]]), " VERSUS CATEG LEVELS LENGTH ", length(unique(data1[[i1]][, categ[[i1]]])), "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}**

*# end conversion of geom\_hline and geom\_vline*

*# kind of geom\_point (vectorial or raster)*

**scatter.kind <- vector("list", length = length(data1))** *# list of same length as data1, that will be used to use either ggplot2::geom\_point() (vectorial dot layer) or fun\_gg\_point\_rast() (raster dot layer)*

**fix.ratio <- FALSE**

**if(is.null(vectorial.limit)){**

**if(raster == TRUE){**

**scatter.kind[] <- "fun\_gg\_point\_rast"** *# not important to fill everything: will be only used when geom == "geom\_point"*

**fix.ratio <- TRUE**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": RASTER PLOT GENERATED -> ASPECT RATIO OF THE PLOT REGION SET TO 1/1 TO AVOID A BUG OF ELLIPSOID DOT DRAWING")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**scatter.kind[] <- "ggplot2::geom\_point"**

**}**

**}else{**

**for(i2 in 1:length(data1)){**

**if(geom[[i2]] == "geom\_point"){**

**if(nrow(data1[[i2]]) <= vectorial.limit){**

**scatter.kind[[i2]] <- "ggplot2::geom\_point"**

**}else{**

**scatter.kind[[i2]] <- "fun\_gg\_point\_rast"**

**fix.ratio <- TRUE**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ", ifelse(length(data1) == 1, "data1", paste0("data1 NUMBER ", i2)), " LAYER AS RASTER (NOT VECTORIAL)")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

**}**

**if(any(unlist(scatter.kind) == "fun\_gg\_point\_rast")){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": RASTER PLOT GENERATED -> ASPECT RATIO OF THE PLOT REGION SET TO 1/1 TO AVOID A BUG OF ELLIPSOID DOT DRAWING")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

*# end kind of geom\_point (vectorial or raster)*

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0**

*# no need loop part*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot())**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::xlab(if(is.null(xlab)){x[[1]]}else{xlab}))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ylab(if(is.null(ylab)){y[[1]]}else{ylab}))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggtitle(title))**

**add.check <- TRUE**

**if( ! is.null(add)){** *# if add is NULL, then = 0*

**if(grepl(pattern = "ggplot2::theme", add) == TRUE){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": \"ggplot2::theme\" STRING DETECTED IN THE add ARGUMENT -> INTERNAL GGPLOT2 THEME FUNCTIONS theme() AND theme\_classic() HAVE BEEN INACTIVATED, TO BE USED BY THE USER.**

**\nIT IS RECOMMENDED TO USE \"+ theme(aspect.ratio = 1)\" IF RASTER MODE IS ACTIVATED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**add.check <- FALSE**

**}**

**}**

**if(add.check == TRUE & classic == TRUE){**

*# BEWARE: not possible to add several times theme(). NO message but the last one overwrites the others*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::theme\_classic(base\_size = text.size))**

**if(grid == TRUE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),** *# draw lines for the y axis*

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),** *# draw lines for the x axis*

**panel.grid.major.x = ggplot2::element\_line(colour = "grey75"),**

**panel.grid.major.y = ggplot2::element\_line(colour = "grey75"),**

**aspect.ratio = if(fix.ratio == TRUE){1}else{NULL}**

**))**

**}else{**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),**

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),**

**aspect.ratio = if(fix.ratio == TRUE){1}else{NULL}**

**))**

**}**

**}else if(add.check == TRUE & classic == FALSE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**panel.background = ggplot2::element\_rect(fill = "grey95"),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),**

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),**

**panel.grid.major.x = ggplot2::element\_line(colour = "grey75"),**

**panel.grid.major.y = ggplot2::element\_line(colour = "grey75"),**

**panel.grid.minor.x = ggplot2::element\_blank(),**

**panel.grid.minor.y = ggplot2::element\_blank(),**

**strip.background = ggplot2::element\_rect(fill = "white", colour = "black"),**

**aspect.ratio = if(fix.ratio == TRUE){1}else{NULL}**

*# do not work -> legend.position = "none" # to remove the legend completely: https://www.datanovia.com/en/blog/how-to-remove-legend-from-a-ggplot/*

**))**

**}**

*# end no need loop part*

*# loop part*

**point.count <- 0**

**line.count <- 0**

**lg.order <- vector(mode = "list", length = 6)** *# order of the legend*

**lg.order <- lapply(lg.order, as.numeric)** *# order of the legend*

**lg.color <- vector(mode = "list", length = 6)** *# color of the legend*

**lg.alpha <- vector(mode = "list", length = 6)** *# order of the legend*

**lg.alpha <- lapply(lg.alpha, as.numeric)** *# alpha of the legend*

**for(i1 in 1:length(data1)){**

**if(geom[[i1]] == "geom\_point"){**

**point.count <- point.count + 1**

**if(point.count == 1){**

**fin.lg.disp[[1]] <- legend.disp[[point.count + line.count]]**

**lg.order[[1]] <- point.count + line.count**

**lg.color[[1]] <- color[[i1]]**

**lg.alpha[[1]] <- alpha[[i1]]**

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = scatter.kind[[i1]]))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], fill = categ[[i1]]), size = dot.size, color = color[[i1]][i5], alpha = alpha[[i1]]))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_fill\_manual(name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = color[[i1]], guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], linetype = 0))))** *# values are the values of fill. order determines the order in the legend*

**}**

**if(point.count == 2){**

**fin.lg.disp[[2]] <- legend.disp[[point.count + line.count]]**

**lg.order[[2]] <- point.count + line.count**

**lg.color[[2]] <- color[[i1]]**

**lg.alpha[[2]] <- alpha[[i1]]**

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = scatter.kind[[i1]]))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], shape = categ[[i1]]), size = dot.size, color = color[[i1]][i5], alpha = alpha[[i1]]))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_shape\_manual(name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = rep(19, length(color[[i1]])), guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], linetype = 0))))** *# values are the values of shape*

**}**

**if(point.count == 3){**

**fin.lg.disp[[3]] <- legend.disp[[point.count + line.count]]**

**lg.order[[3]] <- point.count + line.count**

**lg.color[[3]] <- color[[i1]]**

**lg.alpha[[3]] <- alpha[[i1]]**

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = scatter.kind[[i1]]))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], stroke = categ[[i1]]), size = dot.size, color = color[[i1]][i5], alpha = alpha[[i1]]))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "stroke", name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = rep(0.5, length(color[[i1]])), guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], linetype = 0))))** *# values are the values of stroke*

**}**

**}else{**

**line.count <- line.count + 1**

**if(line.count == 1){**

**fin.lg.disp[[4]] <- legend.disp[[point.count + line.count]]**

**lg.order[[4]] <- point.count + line.count**

**lg.color[[4]] <- color[[i1]]**

**lg.alpha[[4]] <- 1** *# to avoid a bug on windows: if alpha argument is different from 1 for lines (transparency), then lines are not correctly displayed in the legend when using the R GUI (bug https://github.com/tidyverse/ggplot2/issues/2452). No bug when using a pdf*

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = paste("ggplot2::", geom[[i1]], sep ="")))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], linetype = categ[[i1]]), color = color[[i1]][i5], size = line.size, lineend = "round", alpha = alpha[[i1]]))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "linetype", name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = rep(1, length(color[[i1]])), guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], shape = NA))))** *# values are the values of linetype. 1 means solid. Regarding the alpha bug, I have tried different things without success: alpha in guide alone, in geom alone, in both, with different values*

**}**

**if(line.count == 2){**

**fin.lg.disp[[5]] <- legend.disp[[point.count + line.count]]**

**lg.order[[5]] <- point.count + line.count**

**lg.color[[5]] <- color[[i1]]**

**lg.alpha[[5]] <- 1** *# to avoid a bug on windows: if alpha argument is different from 1 for lines (transparency), then lines are not correctly displayed in the legend when using the R GUI (bug https://github.com/tidyverse/ggplot2/issues/2452). No bug when using a pdf*

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = paste("ggplot2::", geom[[i1]], sep ="")))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], alpha = categ[[i1]]), color = color[[i1]][i5], size = line.size, lineend = "round"))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "alpha", name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = rep(alpha[[i1]], length(color[[i1]])), guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], shape = NA))))** *# values are the values of linetype. 1 means solid. Regarding the alpha bug, I have tried different things without success: alpha in guide alone, in geom alone, in both, with different values*

**}**

**if(line.count == 3){**

**fin.lg.disp[[6]] <- legend.disp[[point.count + line.count]]**

**lg.order[[6]] <- point.count + line.count**

**lg.color[[6]] <- color[[i1]]**

**lg.alpha[[6]] <- 1** *# to avoid a bug on windows: if alpha argument is different from 1 for lines (transparency), then lines are not correctly displayed in the legend when using the R GUI (bug https://github.com/tidyverse/ggplot2/issues/2452). No bug when using a pdf*

**class.categ <- levels(factor(data1[[i1]][, categ[[i1]]]))**

**for(i5 in 1:length(color[[i1]])){** *# or length(class.categ). It is the same because already checked that lengths are the same*

**tempo.data.frame <- data1[[i1]][data1[[i1]][, categ[[i1]]] == class.categ[i5], ]**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), eval(parse(text = paste("ggplot2::", geom[[i1]], sep ="")))(data = tempo.data.frame, mapping = ggplot2::aes\_string(x = x[[i1]], y = y[[i1]], size = categ[[i1]]), color = color[[i1]][i5], alpha = alpha[[i1]], lineend = "round"))** *# beware: a single color allowed for color argument outside aesthetic, hence the loop # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "size", name = if(is.null(legend.name)){NULL}else{legend.name[[i1]]}, values = rep(line.size, length(color[[i1]])), guide = ggplot2::guide\_legend(override.aes = list(colour = color[[i1]], shape = NA))))** *# values are the values of linetype. 1 means solid. Regarding the alpha bug, I have tried different things without success: alpha in guide alone, in geom alone, in both, with different values*

**}**

**}**

**}**

*# end loop part*

*# legend display*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::guides(fill = if(fin.lg.disp[[1]] == TRUE){ggplot2::guide\_legend(order = lg.order[[1]], override.aes = list(alpha = lg.alpha[[1]], color = lg.color[[1]]))}else{FALSE}, shape = if(fin.lg.disp[[2]] == TRUE){ggplot2::guide\_legend(order = lg.order[[2]], override.aes = list(alpha = lg.alpha[[2]], color = lg.color[[2]]))}else{FALSE}, stroke = if(fin.lg.disp[[3]] == TRUE){ggplot2::guide\_legend(order = lg.order[[3]], override.aes = list(alpha = lg.alpha[[2]], color = lg.color[[3]]))}else{FALSE}, linetype = if(fin.lg.disp[[4]] == TRUE){ggplot2::guide\_legend(order = lg.order[[4]], override.aes = list(alpha = lg.alpha[[4]], color = lg.color[[4]]))}else{FALSE}, alpha = if(fin.lg.disp[[5]] == TRUE){ggplot2::guide\_legend(order = lg.order[[5]], override.aes = list(alpha = lg.alpha[[5]], color = lg.color[[5]]))}else{FALSE}, size = if(fin.lg.disp[[6]] == TRUE){ggplot2::guide\_legend(order = lg.order[[6]], override.aes = list(alpha = lg.alpha[[6]], color = lg.color[[6]]))}else{FALSE}))** *# clip = "off" to have secondary ticks outside plot region does not work*

*# end legend display*

*# scale management*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::coord\_cartesian(xlim = xlim, ylim = ylim))** *# clip = "off" to have secondary ticks outside plot region does not work*

*# x-axis ticks and inv*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

**tempo.scale <- fun\_scale(lim = xlim, n = ifelse(is.null(x.tick.nb), length(tempo.coord$x.major\_source), x.tick.nb))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_x\_continuous(**

**breaks = tempo.scale,**

**labels = if(xlog == "log10"){scales::trans\_format("identity", scales::math\_format(10^.x))}else if(xlog == "log2"){scales::trans\_format("identity", scales::math\_format(2^.x))}else if(xlog == "no"){ggplot2::waiver()}else{tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 6\n\n============\n\n")) ; stop(tempo.cat)},**

**expand = c(0, 0),**

**limits = NA,**

**trans = ifelse(diff(xlim) < 0, "reverse", "identity")** *# equivalent to ggplot2::scale\_x\_reverse()*

**))**

*# end x-axis ticks and inv*

*# y-axis ticks and inv*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

**tempo.scale <- fun\_scale(lim = ylim, n = ifelse(is.null(y.tick.nb), length(tempo.coord$y.major\_source), y.tick.nb))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_y\_continuous(**

**breaks = tempo.scale,**

**labels = if(ylog == "log10"){scales::trans\_format("identity", scales::math\_format(10^.x))}else if(ylog == "log2"){scales::trans\_format("identity", scales::math\_format(2^.x))}else if(ylog == "no"){ggplot2::waiver()}else{tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 7\n\n============\n\n")) ; stop(tempo.cat)},**

**expand = c(0, 0),**

**limits = NA,**

**trans = ifelse(diff(ylim) < 0, "reverse", "identity")** *# equivalent to ggplot2::scale\_y\_reverse()*

**))**

*# end y-axis ticks and inv*

*# x-axis secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

**xlim.order <- order(xlim)** *# to deal with inverse axis*

**ylim.order <- order(ylim)** *# to deal with inverse axis*

*# no secondary ticks for log2. Play with xlim*

**if(xlog == "log10"){**

**y.range <- tempo.coord$y.range**

**if(diff(ylim.order) < 0){y.range <- -(y.range)}**

**ini.scipen <- options()$scipen**

**options(scipen = -1000)** *# force scientific format*

**power10.exp <- as.integer(substring(text = 10^xlim, first = (regexpr(pattern = "\\+|\\-", text = 10^xlim))))** *# recover the power of 10. Example recover 08 from 1e+08*

**# print(xlim)**

**mantisse <- as.numeric(substr(x = 10^xlim, start = 1, stop = (regexpr(pattern = "\\+|\\-", text = 10^xlim) - 2)))** *# recover the mantisse. Example recover 1.22 from 1.22e+08*

**options(scipen = ini.scipen)** *# restore the initial scientific penalty*

**# print(power10.exp)**

**tempo.tick.pos <- as.vector(outer(log10(2:10), 10^((power10.exp[1] - ifelse(diff(xlim.order) > 0, 1, -1)):(power10.exp[2] + ifelse(diff(xlim.order) > 0, 1, -1)))))**

**tempo.tick.pos <- sort(tempo.tick.pos, decreasing = ifelse(diff(xlim.order) > 0, FALSE, TRUE))**

**tempo.tick.pos <- log10(tempo.tick.pos[tempo.tick.pos >= min(10^xlim) & tempo.tick.pos <= max(10^xlim)])**

**if(any(is.na(tempo.tick.pos) | ! is.finite(tempo.tick.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 8\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", x = tempo.tick.pos, xend = tempo.tick.pos, y = y.range[1], yend = y.range[1] + diff(y.range) / 80))**

**}else if(( ! is.null(x.inter.tick.nb)) & xlog == "no"){**

**if(x.inter.tick.nb > 0){**

**x.ticks.pos <- suppressWarnings(as.numeric(tempo.coord$x.labels))** *# too difficult to predict the behavior of tempo.coord$x.major\_source depending on xlim neg or not, inv or not. Inv is respected*

**if(any(is.na(x.ticks.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 9\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**y.range <- tempo.coord$y.range**

**if(diff(ylim.order) < 0){y.range <- -(y.range)}**

**tick.dist <- mean(diff(x.ticks.pos), na.rm = TRUE)**

**minor.tick.dist <- tick.dist / (x.inter.tick.nb + 1)**

**minor.tick.pos <- seq(x.ticks.pos[1] - tick.dist, x.ticks.pos[length(x.ticks.pos)] + tick.dist, by = minor.tick.dist)**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", x = minor.tick.pos, xend = minor.tick.pos, y = y.range[1], yend = y.range[1] + diff(y.range) / 80))**

**}**

**}**

*# end x-axis secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

*# y-axis secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

*# no secondary ticks for log2. Play with ylim*

**if(ylog == "log10"){**

**x.range <- tempo.coord$x.range**

**if(diff(xlim.order) < 0){x.range <- -(x.range)}**

**ini.scipen <- options()$scipen**

**options(scipen = -1000)** *# force scientific format*

**power10.exp <- as.integer(substring(text = 10^ylim, first = (regexpr(pattern = "\\+|\\-", text = 10^ylim))))** *# recover the power of 10. Example recover 08 from 1e+08*

**mantisse <- as.numeric(substr(x = 10^ylim, start = 1, stop = (regexpr(pattern = "\\+|\\-", text = 10^ylim) - 2)))** *# recover the mantisse. Example recover 1.22 from 1.22e+08*

**options(scipen = ini.scipen)** *# restore the initial scientific penalty*

**tempo.tick.pos <- as.vector(outer(log10(2:10), 10^((power10.exp[1] - ifelse(diff(ylim.order) > 0, 1, -1)):(power10.exp[2] + ifelse(diff(ylim.order) > 0, 1, -1)))))**

**tempo.tick.pos <- sort(tempo.tick.pos, decreasing = ifelse(diff(ylim.order) > 0, FALSE, TRUE))**

**tempo.tick.pos <- log10(tempo.tick.pos[tempo.tick.pos >= min(10^ylim) & tempo.tick.pos <= max(10^ylim)])**

**if(any(is.na(tempo.tick.pos) | ! is.finite(tempo.tick.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 10\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", y = tempo.tick.pos, yend = tempo.tick.pos, x = x.range[1], xend = x.range[1] + diff(x.range) / 80))**

**}else if(( ! is.null(y.inter.tick.nb)) & ylog == "no"){**

**if(y.inter.tick.nb > 0){**

**y.ticks.pos <- suppressWarnings(as.numeric(tempo.coord$y.labels))** *# too difficult to predict the behavior of tempo.coord$y.major\_source depending on ylim neg or not, inv or not. Inv is respected*

**if(any(is.na(y.ticks.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 11\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**x.range <- tempo.coord$x.range**

**if(diff(xlim.order) < 0){x.range <- -(x.range)}**

**tick.dist <- mean(diff(y.ticks.pos), na.rm = TRUE)**

**minor.tick.dist <- tick.dist / (y.inter.tick.nb + 1)**

**minor.tick.pos <- seq(y.ticks.pos[1] - tick.dist, y.ticks.pos[length(y.ticks.pos)] + tick.dist, by = minor.tick.dist)**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", y = minor.tick.pos, yend = minor.tick.pos, x = x.range[1], xend = x.range[1] + diff(x.range) / 80))**

**}**

**}**

*# end y-axis secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

*# end scale management*

**if(plot == TRUE){**

**suppressWarnings(print(eval(parse(text = paste(paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "),if(is.null(add)){NULL}else{add})))))**

**}else{**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": PLOT NOT SHOWN AS REQUESTED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**if(return == TRUE){**

**output <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))**

**if(is.null(unlist(removed.row.nb))){**

**removed.row.nb <- NULL**

**removed.rows <- NULL**

**}else{**

**for(i3 in 1:length(data1)){**

**if( ! is.null(removed.row.nb[[i3]])){**

**removed.row.nb[[i3]] <- sort(removed.row.nb[[i3]])**

**removed.rows[[i3]] <- data1.ini[[i3]][removed.row.nb[[i3]], ]**

**}**

**}**

**}**

**output <- list(data = output$data, removed.row.nb = removed.row.nb, removed.rows = removed.rows, axes = output$layout$panel\_params[[1]], warnings = paste0("\n", warning, "\n\n"))**

**return(output)**

**}**

**}**

######## fun\_gg\_bar\_mean() #### ggplot2 mean barplot + overlaid dots if required



**# Check OK: clear to go Apollo**

**fun\_gg\_bar\_mean <- function(data1, y, categ, categ.class.order = NULL, categ.legend.name = NULL, categ.color = NULL, bar.width = 0.5, error.disp = NULL, error.whisker.width = 0.5, dot.color = "same", dot.tidy = FALSE, dot.bin.nb = 30, dot.jitter = 0.25, dot.size = 3, dot.border.size = 0.5, dot.alpha = 0.5, ylim = NULL, ylog = "no", y.tick.nb = NULL, y.inter.tick.nb = NULL, y.include.zero = FALSE, y.top.extra.margin = 0, y.bottom.extra.margin = 0, stat.disp = NULL, stat.size = 4, stat.dist = 2, xlab = NULL, ylab = NULL, vertical = TRUE, text.size = 12, title = "", title.text.size = 8, text.angle = 0, classic = FALSE, grid = FALSE, return = FALSE, plot = TRUE, add = NULL, warn.print = FALSE, path.lib = NULL){**

*# AIM*

*# ggplot2 vertical barplot representing mean values with the possibility to add error bars and to overlay dots*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# WARNINGS*

*# rows containing NA in data1[, c(y, categ)] will be removed before processing, with a warning (see below)*

*# if ever bars disappear, see the end of https://github.com/tidyverse/ggplot2/issues/2887*

*# to have a single bar, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped bars, create a factor column with a single class and specify this column in categ argument as first element (categ1). See categ below*

*# with several single bars (categ argument with only one element), bar.width argument (i.e., width argument of ggplot2::geom\_bar()) defines each bar width. The bar.width argument also defines the space between bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each bar)*

*# with several sets of grouped bars (categ argument with two elements), bar.width argument defines each set of grouped bar width. The bar.width argument also defines the space between set of grouped bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each set of grouped bar)*

*# to manually change the 0 base bar into this code, see https://stackoverflow.com/questions/35324892/ggplot2-setting-geom-bar-baseline-to-1-instead-of-zero*

*# ARGUMENTS*

*# data1: a dataframe containing one column of values (see y argument below) and one or two columns of categories (see categ argument below). Duplicated column names not allowed*

*# y: character string of the data1 column name for y-axis (containing numeric values). Numeric values will be averaged by categ to generate the bars and will also be used to plot the dots*

*# categ: vector of character strings of the data1 column name for categories (column of characters or factor). Must either be one or two column names. If a single column name (further refered to as categ1), then one bar per class of categ1. If two column names (further refered to as categ1 and categ2), then one bar per class of categ2, which form a group of bars in each class of categ1. BEWARE, categ1 (and categ2 if it exists) must have a single value of y per class of categ1 (and categ2). To have a single bar, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped bars, create a factor column with a single class and specify this column in categ argument as first element (categ1)*

*# categ.class.order: list indicating the order of the classes of categ1 and categ2 represented on the barplot (the first compartment for categ1 and and the second for categ2). If categ.class.order = NULL, classes are represented according to the alphabetical order. Some compartment can be NULL and other not*

*# categ.legend.name: character string of the legend title for categ2. If categ.legend.name = NULL, then categ.legend.name <- categ1 if only categ1 is present and categ.legend.name <- categ2 if categ1 and categ2 are present. Write "" if no legend required*

*# categ.color: vector of character color string for bar filling. If categ.color = NULL, default colors of ggplot2, whatever categ1 and categ2. If categ.color is non null and only categ1 in categ argument, categ.color can be either: (1) a single color string (all the bars will have this color, whatever the classes of categ1), (2) a vector of string colors, one for each class of categ1 (each color will be associated according to categ.class.order of categ1), (3) a vector or factor of string colors, like if it was one of the column of data1 data frame (beware: a single color per class of categ1 and a single class of categ1 per color must be respected). Integers are also accepted instead of character strings, as long as above rules about length are respected. Integers will be processed by fun\_gg\_palette() using the max integer value among all the integers in categ.color. If categ.color is non null and categ1 and categ2 specified, all the rules described above will apply to categ2 instead of categ1 (colors will be determined for bars inside a group of bars)*

*# bar.width: numeric value (from 0 to 1) of the bar or set of grouped bar width (see warnings above)*

*# error.disp: either "SD", "SD.TOP", "SEM" or "SEM.TOP". If NULL, no error bars added*

*# error.whisker.width: numeric value (from 0 to 1) of the whisker (error bar extremities) width, with 0 meaning no whiskers and 1 meaning a width equal to the corresponding bar width*

*# dot.color: vector of character string. Idem as categ.color but for dots, except that in the possibility (3), the rule "a single color per class of categ1 and a single class of categ1", cannot be respected (each dot can have a different color). If NULL, no dots plotted*

*# dot.tidy: logical. Nice dot spreading? If TRUE, use the geom\_dotplot() function for a nice representation. If FALSE, dots are randomly spread, using the dot.jitter argument (see below)*

*# dot.bin.nb: positive integer indicating the number of bins (i.e., nb of separations) of the ylim range. Each dot will then be put in one of the bin, with the size the width of the bin. Not considered if dot.tidy is FALSE*

*# dot.jitter: numeric value (from 0 to 1) of random dot horizontal dispersion, with 0 meaning no dispersion and 1 meaning a dispersion in the corresponding bar width interval. Not considered if dot.tidy is TRUE*

*# dot.size: numeric value of dot size. Not considered if dot.tidy is TRUE*

*# dot.border.size: numeric value of border dot size. Write zero for no dot border. If dot.tidy is TRUE, value 0 remove the border. Another one leave the border without size control (geom\_doplot() feature)*

*# dot.alpha: numeric value (from 0 to 1) of dot transparency (full transparent to full opaque, respectively)*

*# ylim: 2 numeric values for y-axis range. If NULL, range of y in data1. Order of the 2 values matters (for inverted axis). BEWARE: values of the ylim must be already in the corresponding log if ylog argument is not "no" (see below)*

*# ylog: Either "no" (values in the y argument column of the data1 data frame are not log), "log2" (values in the y argument column of the data1 data frame are log2 transformed) or "log10" (values in the y argument column of the data1 data frame are log10 transformed). BEWARE: do not tranform the data, but just display ticks in a log scale manner. Thus, negative or zero values allowed. BEWARE: not possible to have horizontal bars with a log axis, due to a bug in ggplot2 (see https://github.com/tidyverse/ggplot2/issues/881)*

*# y.tick.nb: approximate number of desired label values on the y-axis (n argument of the the fun\_scale() function)*

*# y.inter.tick.nb: number of desired secondary ticks between main ticks. Not considered if ylog is other than "no". In that case, play with the ylim and y.tick.nb arguments*

*# y.include.zero: logical. Does ylim range include 0? Ok even if ylog = TRUE because ylim must already be log transformed values*

*# y.top.extra.margin: single proportion (between 0 and 1) indicating if extra margins must be added to ylim. If different from 0, add the range of the axis \* y.top.extra.margin (e.g., abs(ylim[2] - ylim[1]) \* y.top.extra.margin) to the top of y-axis*

*# y.bottom.extra.margin: idem as y.top.extra.margin but to the bottom of y-axis*

*# stat.disp: add the mean number above the corresponding bar. Either NULL (no number shown), "top" (at the top of the figure region) or "above" (above each bar)*

*# stat.size: numeric value of the stat size (in points). Increase the value to increase text size*

*# stat.dist: numeric value of the stat distance. Increase the value to increase the distance*

*# xlab: a character string or expression for x-axis legend. If NULL, character string of categ1*

*# ylab: a character string or expression for y-axis legend. If NULL, character string of the y argument*

*# vertical: logical. Vertical bars? BEWARE: will be automatically set to TRUE if ylog argument is other than "no". Indeed, not possible to have horizontal bars with a log axis, due to a bug in ggplot2 (see https://github.com/tidyverse/ggplot2/issues/881)*

*# text.size: numeric value of the size of the (1) axis numbers and axis legends, (2) texts in the graphic legend, (3) stats above bars (in points)*

*# title: character string of the graph title*

*# title.text.size: numeric value of the title size (in points)*

*# text.angle: integer value of the text angle for the x-axis labels. Positive values for counterclockwise rotation: 0 for horizontal, 90 for vertical, 180 for upside down etc. Negative values for clockwise rotation: 0 for horizontal, -90 for vertical, -180 for upside down etc.*

*# classic: logical. Use the classic theme (article like)?*

*# grid: logical. draw horizontal lines in the background to better read the bar values? Not considered if classic = FALSE*

*# return: logical. Return the graph parameters?*

*# plot: logical. Plot the graphic? If FALSE and return argument is TRUE, graphical parameters and associated warnings are provided without plotting*

*# add: character string allowing to add more ggplot2 features (dots, lines, themes, etc.). BEWARE: (1) must start with "+" just after the simple or double opening quote (no space, end of line, carriage return, etc., allowed), (2) must finish with ")" just before the simple or double closing quote (no space, end of line, carriage return, etc., allowed) and (3) each function must be preceded by "ggplot2::" (for instance: "ggplot2::coord\_flip()). If the character string contains the "ggplot2::theme" string, then internal ggplot2 theme() and theme\_classic() functions will be inactivated to be reused by add. BEWARE: handle this argument with caution since added functions can create conflicts with the preexisting internal ggplot2 functions*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# scales*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_2d\_comp()*

*# fun\_gg\_just()*

*# fun\_gg\_palette()*

*# fun\_name\_change()*

*# fun\_pack()*

*# fun\_check()*

*# fun\_round()*

*# fun\_scale()*

*# RETURN*

*# a barplot if plot argument is TRUE*

*# a list of the graph info if return argument is TRUE:*

*# $stat: the graphic statistics*

*# $removed.row.nb: which rows have been removed due to NA detection in y and categ columns (NULL if no row removed)*

*# $removed.rows: removed rows containing NA (NULL if no row removed)*

*# $data: the graphic bar and dot coordinates*

*# $axes: the x-axis and y-axis info*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# nice representation (1)*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), categ.class.order = list(NULL, c("B", "A")), categ.legend.name = "LEGEND", categ.color = NULL, bar.width = 0.3, error.disp = "SD.TOP", error.whisker.width = 0.8, dot.color = "same", dot.jitter = 0.5, dot.size = 3.5, dot.border.size = 0.2, dot.alpha = 0.5, ylim = c(10, 25), y.include.zero = TRUE, stat.disp = "above", stat.size = 4, xlab = "GROUP", ylab = "MEAN", text.size = 12, title = "GRAPH1", title.text.size = 8, text.angle = 0, classic = TRUE, grid = TRUE)*

*# nice representation (2)*

*# set.seed(1) ; obs1 <- data.frame(Time = c(rnorm(24, 0), rnorm(24, -10), rnorm(24, 10), rnorm(24, 20)), Group1 = rep(c("CAT", "DOG"), times = 48), Group2 = rep(c("A", "B", "C", "D"), each = 24)) ; set.seed(NULL) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), categ.class.order = list(NULL, c("B", "A", "D", "C")), categ.legend.name = "LEGEND", categ.color = NULL, bar.width = 0.8, dot.color = "grey50", dot.tidy = TRUE, dot.bin.nb = 60, dot.size = 3.5, dot.border.size = 0.2, dot.alpha = 0.5, ylim= c(-20, 30), stat.disp = "above", stat.size = 4, stat.dist = 1, xlab = "GROUP", ylab = "MEAN", vertical = FALSE, text.size = 12, title = "GRAPH1", title.text.size = 8, text.angle = 45, classic = FALSE)*

*# simple example*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1")*

*# separate bars. Example (1) of modification of bar color using a single value*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", categ.color = "white")*

*# separate bars. Example (2) of modification of bar color using one value par class of categ2*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", categ.color = c("coral", "lightblue"))*

*# separate bars. Example (3) of modification of bar color using the bar.color data frame column, with respect of the correspondence between categ2 and bar.color columns*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), bar.color = rep(c("coral", "lightblue"), time = 10)) ; obs1 ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", categ.color = obs1$bar.color)*

*# separate bars. Example (1) of modification of dot color, using the same dot color as the corresponding bar*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = "same")*

*# separate bars. Example (2) of modification of dot color, using a single color for all the dots*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = "green")*

*# separate bars. Example (3) of modification of dot color, using one value par class of categ2*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = c("green", "brown"))*

*# separate bars. Example (4) of modification of dot color, using different colors for each dot*

*# obs1 <- data.frame(Time = 1:10, Group1 = rep(c("G", "H"), times = 5)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = hsv(h = (1:nrow(obs1)) / nrow(obs1)))*

*# grouped bars. Simple example*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"))*

*# grouped bars. More grouped bars*

*# obs1 <- data.frame(Time = 1:24, Group1 = rep(c("G", "H"), times = 12), Group2 = rep(c("A", "B", "C", "D"), each = 6)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"))*

*# grouped bars. Example (1) of modification of bar color, using a single value*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), categ.color = "white")*

*# grouped bars. Example (2) of modification of bar color, using one value par class of categ2*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), categ.color = c("coral", "lightblue"))*

*# grouped bars. Example (3) of modification of bar color, using one value per line of obs1, with respect of the correspondence between categ2 and bar.color columns*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("coral", "lightblue"), each = 10)) ; obs1 ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), categ.color = obs1$bar.color)*

*# grouped bars. Example (1) of modification of dot color, using the same dot color as the corresponding bar*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "same")*

*# grouped bars. Example (2) of modification of dot color, using a single color for all the dots*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "green")*

*# grouped bars. Example (3) of modification of dot color, using one value par class of categ2*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = c("green", "brown"))*

*# grouped bars. Example (4) of modification of dot color, using different colors for each dot*

*# obs1 <- data.frame(Time = 1:10, Group1 = rep(c("G", "H"), times = 5), Group2 = rep(c("A", "B"), each = 5)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = hsv(h = (1:nrow(obs1)) / nrow(obs1)))*

*# no dots (y.include.zero set to TRUE to see the lowest bar):*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, y.include.zero = TRUE)*

*# bar width. Example (1) with bar.width = 0.25 -> three times more space between single bars than the bar width (y.include.zero set to TRUE to see the lowest bar)*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), each = 500)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = NULL, y.include.zero = TRUE, bar.width = 0.25)*

*# bar width. Example (2) with bar.width = 1, no space between single bars*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), each = 500)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = "Group1", dot.color = NULL, y.include.zero = TRUE, bar.width = 1)*

*# bar width. Example (3) with bar.width = 0.25 -> three times more space between sets of grouped bars than the set width*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, y.include.zero = TRUE, bar.width = 0.25)*

*# bar width. Example (4) with bar.width = 0 -> no space between sets of grouped bars*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, y.include.zero = TRUE, bar.width = 1)*

*# error bars*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, error.disp = "SD.TOP")*

*# whisker width. Example (1) with error.whisker.width = 1 -> whiskers have the width of the corresponding bar*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, error.disp = "SD", error.whisker.width = 1)*

*# whisker width. Example (2) error bars with no whiskers*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = NULL, error.disp = "SD", error.whisker.width = 0)*

*# tidy dot distribution. Example (1)*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "same", dot.tidy = TRUE, dot.bin.nb = 100)*

*# tidy dot distribution. Example (2) reducing the dot size with dot.bin.nb*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "same", dot.tidy = TRUE, dot.bin.nb = 150)*

*# dot jitter. Example (1)*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "same", dot.tidy = FALSE, dot.jitter = 1, dot.size = 2)*

*# dot jitter. Example (2) with dot.jitter = 1 -> dispersion around the corresponding bar width*

*# obs1 <- data.frame(Time = 1:1000, Group1 = rep(c("G", "H"), times = 500), Group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "grey", dot.size = 3, dot.alpha = 1, dot.jitter = 1)*

*# dot jitter. Example (3) with no dispersion*

*# obs1 <- data.frame(Time = 1:100, Group1 = rep(c("G", "H"), times = 50), Group2 = rep(LETTERS[1:5], each = 20)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "grey", dot.size = 3, dot.alpha = 1, dot.jitter = 0)*

*# dot size, dot border size and dot transparency*

*# obs1 <- data.frame(Time = 1:100, Group1 = rep(c("G", "H"), times = 50), Group2 = rep(LETTERS[1:5], each = 20)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), dot.color = "grey", dot.size = 4, dot.border.size = 0, dot.alpha = 0.6)*

*# y-axis limits. Example (1)*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylim = c(-1, 25))*

*# y-axis limits. Example (2) showing that order matters in ylim argument*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylim = c(25, -1))*

*# log scale. Example (1). BEWARE: y column must be log, otherwise incoherent scale (see below warning message with the return argument)*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10")*

*# log scale. Example (2). BEWARE: values of the ylim must be in the corresponding log*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", ylim = c(1,4))*

*# tick number. Example (1)*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.tick.nb = 10)*

*# tick number. Example (2) using a log2 scale*

*# obs1 <- data.frame(Time = log2((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log2", y.tick.nb = 10, ylim = c(1, 16))*

*# tick number. Example (3) using a log10 scale*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", y.tick.nb = 10)*

*# tick number. Example (4) using a log10 scale: the reverse y-axis correctly deal with log10 scale*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", y.tick.nb = 10, ylim = c(4, 1))*

*# secondary tick number. Example (1)*

*# obs1 <- data.frame(Time = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.inter.tick.nb = 2)*

*# secondary ticks. Example (2) not for log2 and log10 scales (see below warning message with the return argument)*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", y.inter.tick.nb = 2)*

*# include zero in the y-axis*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.include.zero = TRUE)*

*# extra margins. To avoid dot cuts*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.top.extra.margin = 0.25, y.bottom.extra.margin = 0.25)*

*# mean diplay. Example (1) at the top of the plot region*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.top.extra.margin = 0.1, stat.disp = "top", stat.size = 4, stat.dist = 2)*

*# mean diplay. Example (2) above bars*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.top.extra.margin = 0.1, stat.disp = "above", stat.size = 4, stat.dist = 2)*

*# bar orientation. Example (1) without log scale, showing that the other arguments are still operational*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), y.tick.nb = 10, y.inter.tick.nb = 2, y.include.zero = TRUE, vertical = FALSE)*

*# bar orientation. Example (2) with log scale. Horizontal orientation is blocked with log2 and log10 scales because of a bug in ggplot2 (https://github.com/tidyverse/ggplot2/issues/881)*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", vertical = FALSE)*

*# classic representation (use grid = TRUE to display the background lines of the y axis ticks)*

*# obs1 <- data.frame(Time = (1:20), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), classic = TRUE, grid = FALSE)*

*# graphic info. Example (1)*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), return = TRUE)*

*# graphic info. Example (2) of assignation and warning message display*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; warn <- fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), ylog = "log10", return = TRUE) ; cat(warn$warnings)*

*# add ggplot2 functions*

*# obs1 <- data.frame(Time = log10((1:20) \* 100), Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "Time", categ = c("Group1", "Group2"), add = "+ggplot2::theme\_classic()")*

*# all the arguments*

*# obs1 <- data.frame(x = 1:20, Group1 = rep(c("G", "H"), times = 10), Group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "x", categ = c("Group1", "Group2"), categ.class.order = list(NULL, c("B", "A")), categ.legend.name = "", categ.color = c("red", "blue"), bar.width = 0.25, error.disp = "SD", error.whisker.width = 0.8, dot.color = "grey", dot.tidy = FALSE, dot.bin.nb = 30, dot.jitter = 1, dot.size = 4, dot.border.size = 0, dot.alpha = 1, ylim = c(0, 25), ylog = "no", y.tick.nb = NULL, y.inter.tick.nb = NULL, y.include.zero = FALSE, y.top.extra.margin = 0.05, y.bottom.extra.margin = 0, stat.disp = "above", stat.size = 4, stat.dist = 2, xlab = "GROUP", ylab = "MEAN", vertical = FALSE, text.size = 12, title = "", title.text.size = 8, text.angle = 45, classic = TRUE, grid = TRUE, return = TRUE, plot = TRUE, add = NULL, warn.print = TRUE, path.lib = NULL)*

*# DEBUGGING*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("brown", "orange"), each = 10)) ; data1[2:3, 1] <- NA ; data1[7:8, 2] <- NA ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; categ.class.order = list(L1 = NULL, L2 = c("B", "A")) ; categ.legend.name = NULL ; categ.color = na.omit(data1)$bar.color ; bar.width = 0.5 ; error.disp = "SD" ; error.whisker.width = 0.5 ; dot.color = "same" ; dot.tidy = FALSE ; dot.bin.nb = 30 ; dot.jitter = 0.25 ; dot.size = 3 ; dot.border.size = 0.5 ; dot.alpha = 1 ; ylim = NULL ; ylog = "no" ; y.tick.nb = NULL ; y.inter.tick.nb = NULL ; y.include.zero = FALSE ; y.top.extra.margin = 0.05 ; y.bottom.extra.margin = 0 ; stat.disp = NULL ; stat.size = 4 ; stat.dist = 2 ; xlab = NULL ; ylab = NULL ; vertical = TRUE ; text.size = 12 ; title = "" ; title.text.size = 8 ; text.angle = 0 ; classic = FALSE ; grid = FALSE ; return = FALSE ; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# data1 <-data.frame(a = rep(1:20, 5), group1 = rep(c("G", "H"), times = 50), group2 = rep(LETTERS[1:5], each = 20)) ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; categ.class.order = list(L1 = NULL, L2 = c("B", "A", "E", "D", "C")) ; categ.legend.name = NULL ; categ.color = NULL ; bar.width = 0.5 ; error.disp = "SD" ; error.whisker.width = 0.5 ; dot.color = "same" ; dot.tidy = TRUE ; dot.bin.nb = 30 ; dot.jitter = 0.25 ; dot.size = 3 ; dot.border.size = 0.5 ; dot.alpha = 1 ; ylim = NULL ; ylog = "no" ; y.tick.nb = NULL ; y.inter.tick.nb = NULL ; y.include.zero = FALSE ; y.top.extra.margin = 0.05 ; y.bottom.extra.margin = 0 ; stat.disp = NULL ; stat.size = 4 ; stat.dist = 2 ; xlab = NULL ; ylab = NULL ; vertical = TRUE ; text.size = 12 ; title = "" ; title.text.size = 8 ; text.angle = 0 ; classic = FALSE ; grid = FALSE ; return = FALSE; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("brown", "orange"), each = 10)) ; data1[2:3, 1] <- NA ; data1[7:8, 2] <- NA ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; categ.class.order = list(L1 = NULL, L2 = c("B", "A")) ; categ.legend.name = NULL ; categ.color = na.omit(data1)$bar.color ; bar.width = 0.5 ; error.disp = "SD" ; error.whisker.width = 0.5 ; dot.color = "same" ; dot.tidy = TRUE ; dot.bin.nb = 30 ; dot.jitter = 0.25 ; dot.size = 3 ; dot.border.size = 0.5 ; dot.alpha = 1 ; ylim = NULL ; ylog = "no" ; y.tick.nb = NULL ; y.inter.tick.nb = NULL ; y.include.zero = FALSE ; y.top.extra.margin = 0.05 ; y.bottom.extra.margin = 0 ; stat.disp = "above" ; stat.size = 4 ; stat.dist = 2 ; xlab = NULL ; ylab = NULL ; vertical = TRUE ; text.size = 12 ; title = "" ; title.text.size = 8 ; text.angle = 0 ; classic = FALSE ; grid = FALSE ; return = FALSE; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# set.seed(1) ; data1 <- data.frame(a = c(rnorm(25, 0), rnorm(25, -10), rnorm(25, 10), rnorm(25, 20)), group1 = rep(c("G", "H"), times = 50), group2 = rep(c("A", "B", "C", "D"), each = 25)) ; set.seed(NULL) ; y = "Time" ; categ = c("group1", "group2") ; categ.class.order = list(NULL, c("B", "A", "D", "C")) ; categ.legend.name = "LEGEND" ; categ.color = NULL ; bar.width = 0.8 ; error.disp = "SD" ; error.whisker.width = 0.5 ; dot.color = "same" ; dot.tidy = TRUE ; dot.bin.nb = 60 ; dot.jitter = 0.25 ; dot.size = 3.5 ; dot.border.size = 0 ; dot.alpha = 1 ; ylim= c(-15, 25) ; ylog = "no" ; y.tick.nb = NULL ; y.inter.tick.nb = NULL ; y.include.zero = "no" ; y.top.extra.margin = 0.05 ; y.bottom.extra.margin = 0 ; stat.disp = "above" ; stat.size = 4 ; stat.dist = 2 ; xlab = "GROUP" ; ylab = "MEAN" ; vertical = FALSE ; text.size = 12 ; title = "" ; title.text.size = 8 ; text.angle = -200 ; classic = FALSE ; grid = FALSE ; return = FALSE; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# set.seed(1) ; data1 <- data.frame(x = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; set.seed(NULL) ; y = "x" ; categ <- c("group1", "group2") ; categ.class.order = list(NULL, c("B", "A", "D", "C", "E")) ; categ.legend.name = "LEGEND" ; categ.color = NULL ; bar.width = 0.8 ; error.disp = "SD" ; error.whisker.width = 1 ; dot.color = NULL ; dot.tidy = FALSE ; dot.bin.nb = 60 ; dot.jitter = 0.25 ; dot.size = 3.5 ; dot.border.size = 0.2 ; dot.alpha = 1 ; ylim= c(1, 4) ; ylog = "log10" ; y.tick.nb = NULL ; y.inter.tick.nb = NULL ; y.include.zero = FALSE ; y.top.extra.margin = 0 ; y.bottom.extra.margin = 0 ; stat.disp = "above" ; stat.size = 4 ; stat.dist = 1 ; xlab = "GROUP" ; ylab = "MEAN" ; vertical = TRUE ; text.size = 12 ; title = "" ; title.text.size = 8 ; text.angle = -200 ; classic = FALSE ; grid = FALSE ; return = FALSE; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_2d\_comp", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_2d\_comp() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_just", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_just() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_palette", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_palette() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_name\_change", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_name\_change() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_round", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_round() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_scale", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_scale() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# reserved words to avoid bugs (used in this function)*

**reserved.words <- c("categ.check", "categ.color", "dot.color", "dot.max", "dot.min", "ERROR.INF", "ERROR.SUP", "group", "group.check", "max.dot.error", "MEAN", "min.dot.error", "SD", "SEM", "tempo.categ1", "tempo.categ2", "text.max.pos", "text.min.pos", "x", "x.y", "y", "y.check", "y\_from.dot.max", "ymax")**

*# end reserved words to avoid bugs (used in this function)*

*# argument checking (and modification for proper color management)*

**warning <- NULL**

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data1, class = "data.frame", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & any(duplicated(names(data1)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DUPLICATED COLUMN NAMES OF data1 ARGUMENT NOT ALLOWED:\n", paste(names(data1)[duplicated(names(data1))], collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = y, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (y %in% names(data1))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y ARGUMENT MUST BE A COLUMN NAME OF data1\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE){**

**tempo <- fun\_check(data = data1[, y], data.name = "y COLUMN OF data1", class = "vector", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = categ, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & length(categ) > 2){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ ARGUMENT CANNOT HAVE MORE THAN 2 COLUMN NAMES OF data1\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! all(categ %in% names(data1))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ ARGUMENT MUST BE COLUMN NAMES OF data1. HERE IT IS:\n", paste(categ, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

*# reserved word checking*

**if(any(names(data1) %in% reserved.words)){**

**if(any(duplicated(names(data1)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DUPLICATED COLUMN NAMES OF data1 ARGUMENT NOT ALLOWED:\n", paste(names(data1)[duplicated(names(data1))], collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo.output <- fun\_name\_change(names(data1), reserved.words)**

**for(i3 in 1:length(tempo.output$ini)){** *# a loop to be sure to take the good ones*

**names(data1)[names(data1) == tempo.output$ini[i3]] <- tempo.output$post[i3]**

**if(any(y == tempo.output$ini[i3])){**

**y[y == tempo.output$ini[i3]] <- tempo.output$post[i3]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN y ARGUMENT (COLUMN NAMES OF data1 ARGUMENT),\n", tempo.output$ini[i3], " HAS BEEN REPLACED BY ", tempo.output$post[i3], "\nBECAUSE RISK OF BUG AS SOME NAMES IN y ARGUMENT ARE RESERVED WORD USED BY THE ", function.name, " FUNCTION")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if(any(categ == tempo.output$ini[i3])){**

**categ[categ == tempo.output$ini[i3]] <- tempo.output$post[i3]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN categ ARGUMENT (COLUMN NAMES OF data1 ARGUMENT),\n", tempo.output$ini[i3], " HAS BEEN REPLACED BY ", tempo.output$post[i3], "\nBECAUSE RISK OF BUG AS SOME NAMES IN categ ARGUMENT ARE RESERVED WORD USED BY THE ", function.name, " FUNCTION")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": REGARDING COLUMN NAMES REPLACEMENT, TOTALLY THE NAMES,\n", paste(tempo.output$ini, collapse = " "), "\nHAVE BEEN REPLACED BY\n", paste(tempo.output$post, collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end reserved word checking*

*# na detection and removal (done now to be sure of the correct length of categ)*

**if(any(is.na(data1[, c(y, categ)]))){**

**removed.row.nb <- unlist(lapply(lapply(c(data1[c(y, categ)]), FUN = is.na), FUN = which))**

**removed.rows <- data1[removed.row.nb, ]**

**data1 <- data1[-removed.row.nb, ]**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NA DETECTED IN COLUMN ", paste(c(y, categ), collapse = " "), " OF data1 AND CORRESPONDING ROWS REMOVED (SEE $removed.row.nb AND $removed.rows)")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**removed.row.nb <- NULL**

**removed.rows <- NULL**

**}**

*# end na detection and removal (done now to be sure of the correct length of categ)*

**for(i1 in 1:length(categ)){**

**if(any(is.na(data1[, categ[i1]]))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN categ NUMBER ", i1, " IN data1, THE CATEGORY COLUMN ", categ[i1], " CONTAINS NA")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**tempo1 <- fun\_check(data = data1[, categ[i1]], data.name = paste0("categ NUMBER ", i1, " OF data1"), class = "vector", mode = "character", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**tempo2 <- fun\_check(data = data1[, categ[i1]], data.name = paste0("categ NUMBER ", i1, " OF data1"), class = "factor", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ", paste0("categ NUMBER ", i1, " OF data1"), " MUST BE A FACTOR OR CHARACTER VECTOR\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo1$problem == FALSE){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN categ NUMBER ", i1, " IN data1, THE CHARACTER COLUMN HAS BEEN CONVERTED TO FACTOR")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**data1[, categ[i1]] <- factor(data1[, categ[i1]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**}**

**if( ! is.null(categ.class.order)){**

**tempo <- fun\_check(data = categ.class.order, class = "list", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & length(categ.class.order) > 2){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ.class.order ARGUMENT MUST BE A LIST OF MAX LENGTH 2\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE){**

**for(i3 in 1:length(categ.class.order)){**

**if(is.null(categ.class.order[[i3]])){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE categ.class.order COMPARTMENT ", i3, " IS NULL. ALPHABETICAL ORDER WILL BE APPLIED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**data1[, categ[i3]] <- factor(as.character(data1[, categ[i3]]))** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**}else if(any(duplicated(categ.class.order[[i3]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": COMPARTMENT ", i3, " OF categ.class.order ARGUMENT CANNOT HAVE DUPLICATED CLASSES: ", paste(categ.class.order[[i3]], collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if( ! (all(categ.class.order[[i3]] %in% unique(data1[, categ[i3]])) & all(unique(data1[, categ[i3]]) %in% categ.class.order[[i3]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": COMPARTMENT ", i3, " OF categ.class.order ARGUMENT MUST BE CLASSES OF ELEMENT ", i3, " OF categ\nHERE IT IS:\nCOMPARTMENT ", i3, " OF categ.class.order:", paste(categ.class.order[[i3]], collapse = " "), "\nCOLUMN ", categ[i3], " OF data1: ", paste( unique(data1[, categ[i3]]), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{**

**data1[, categ[i3]] <- factor(data1[, categ[i3]], levels = categ.class.order[[i3]])** *# reorder the factor*

**}**

**}**

**}**

**}**

**if( ! is.null(categ.legend.name)){**

**tempo <- fun\_check(data = categ.legend.name, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**}else{**

**categ.legend.name <- categ[length(categ)]** *# if only categ1, then legend name of categ1, if length(categ) == 2, then legend name of categ2*

**}**

**if( ! is.null(categ.color)){**

*# check the nature of color*

**tempo1 <- fun\_check(data = categ.color, class = "vector", mode = "character", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**tempo2 <- fun\_check(data = categ.color, class = "factor", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

*# integer colors into gg\_palette*

**tempo.check.color <- fun\_check(data = categ.color, class = "integer", double.as.integer.allowed = TRUE, na.contain = TRUE, fun.name = function.name, print = FALSE)$problem**

**if(tempo.check.color == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ.color MUST BE A FACTOR OR CHARACTER VECTOR OR INTEGER VECTOR\n\n================\n\n")** *# integer possible because dealt above*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{** *# convert integers into colors*

**categ.color <- fun\_gg\_palette(max(categ.color, na.rm = TRUE))**

**}**

*# end integer colors into gg\_palette*

**}**

**if( ! (all(categ.color %in% colors() | grepl(pattern = "^#", categ.color)))){** *# check that all strings of low.color start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ.color ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors(): ", paste(unique(categ.color), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if(any(is.na(categ.color))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": categ.color ARGUMENT CONTAINS NA")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end check the nature of color*

*# check the length of color*

*# No problem of NA management by ggplot2 because already removed*

**i0 <- length(categ)** *# if only categ1, then colors for classes of categ1, if length(categ) == 2, then colors for classes of categ2*

**if(length(categ.color) == length(unique(data1[, categ[i0]]))){** *# here length(categ.color) is equal to the different number of categ*

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**data1 <- data.frame(data1, categ.color = data1[, categ[i0]])**

**levels(data1$categ.color) <- categ.color**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", categ[i0], " OF categ ARGUMENT, THE FOLLOWING COLORS:\n", paste(categ.color, collapse = " "), "\nHAVE BEEN ATTRIBUTED TO THESE CLASSES:\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(length(categ.color) == length(data1[, categ[i0]])){***# here length(categ.color) is equal to nrow(data1) -> Modif to have length(categ.color) equal to the different number of categ (length(categ.color) == length(levels(data1[, categ[i0]])))*

**data1 <- data.frame(data1, categ.color = categ.color)**

**tempo.check <- unique(data1[ , c(categ[i0], "categ.color")])**

**if( ! (nrow(tempo.check) == length(unique(categ.color)) & nrow(tempo.check) == length(unique(data1[ , categ[i0]])))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ.color ARGUMENT HAS THE LENGTH OF data1 ROW NUMBER\nBUT IS INCORRECTLY ASSOCIATED TO EACH CLASS OF categ ", categ[i0], ":\n", paste(unique(mapply(FUN = "paste", data1[ ,categ[i0]], data1[ ,"categ.color"])), collapse = "\n"), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{**

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**categ.color <- unique(categ.color[order(data1[, categ[i0]])])** *# Modif to have length(categ.color) equal to the different number of categ (length(categ.color) == length(levels(data1[, categ[i0]])))*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": categ.color ARGUMENT HAS THE LENGTH OF data1 ROW NUMBER\nCOLORS HAVE BEEN RESPECTIVELY ASSOCIATED TO EACH CLASS OF categ ", categ[i0], " AS:\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "), "\n", paste(categ.color, collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}else if(length(categ.color) == 1){**

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**data1 <- data.frame(data1, categ.color = categ.color)**

**categ.color <- rep(categ.color, length(levels(data1[, categ[i0]])))**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": categ.color ARGUMENT HAS LENGTH 1, MEANING THAT ALL THE DIFFERENT CLASSES OF ", categ[i0], "\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "), "\nWILL HAVE THE SAME COLOR\n", paste(categ.color, collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": categ.color ARGUMENT MUST BE (1) LENGTH 1, OR (2) THE LENGTH OF data1 NROWS, OR (3) THE LENGTH OF THE CLASSES IN THE categ ", categ[i0], " COLUMN. HERE IT IS COLOR LENGTH ", length(categ.color), " VERSUS CATEG LENGTH ", length(data1[, categ[i0]]), " AND CATEG CLASS LENGTH ", length(unique(data1[, categ[i0]])), "\nPRESENCE OF NA COULD BE THE PROBLEM\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}else{**

**i0 <- length(categ)** *# if only categ1, then colors for classes of categ1, if length(categ) == 2, then colors for classes of categ2*

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**categ.color <- fun\_gg\_palette(length(levels(data1[, categ[i0]])))**

**data1 <- data.frame(data1, categ.color = data1[, categ[i0]])**

**levels(data1$categ.color) <- categ.color**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NULL categ.color ARGUMENT -> COLORS RESPECTIVELY ATTRIBUTED TO EACH CLASS OF ", categ[i0], " IN data1:\n", paste(categ.color, collapse = " "), "\n", paste(levels(data1[, categ[i0]]), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**tempo <- fun\_check(data = bar.width, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(error.disp)){**

**tempo <- fun\_check(data = error.disp, options = c("SD", "SD.TOP", "SEM", "SEM.TOP"), length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = error.whisker.width, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(dot.color)){**

*# check the nature of color*

**tempo1 <- fun\_check(data = dot.color, class = "vector", mode = "character", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**tempo2 <- fun\_check(data = dot.color, class = "factor", na.contain = TRUE, fun.name = function.name, print = FALSE)**

**if(tempo1$problem == TRUE & tempo2$problem == TRUE){**

*# integer colors into gg\_palette*

**tempo.check.color <- fun\_check(data = dot.color, class = "integer", double.as.integer.allowed = TRUE, na.contain = TRUE, fun.name = function.name, print = FALSE)$problem**

**if(tempo.check.color == TRUE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": dot.color MUST BE A FACTOR OR CHARACTER VECTOR OR INTEGER VECTOR\n\n================\n\n")** *# integer possible because dealt above*

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else{** *# convert integers into colors*

**dot.color <- fun\_gg\_palette(max(dot.color, na.rm = TRUE))**

**}**

*# end integer colors into gg\_palette*

**}**

**if(all(dot.color == "same") & length(dot.color) == 1){**

**dot.color <- categ.color** *# same color of the dots as the corresponding bar color*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": dot.color ARGUMENT HAS BEEN SET TO \"SAME\"\nTHUS, DOT COLORS HAVE BEEN RESPECTIVELY ASSOCIATED TO EACH CLASS OF categ ", categ[i0], " AS:\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "), "\n", paste(levels(factor(dot.color)), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if( ! (all(dot.color %in% colors() | grepl(pattern = "^#", dot.color)))){** *# check that all strings of low.color start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": dot.color ARGUMENT MUST BE (1) A HEXADECIMAL COLOR VECTOR STARTING BY #, OR (2) COLOR NAMES GIVEN BY colors(), OR (3) INTEGERS, OR THE STRING\"same\"\nHERE IT IS: ", paste(unique(dot.color), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if(any(is.na(dot.color))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": dot.color ARGUMENT CONTAINS NA")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end check the nature of color*

*# check the length of color*

*# No problem of NA management by ggplot2 because already removed*

**i0 <- length(categ)** *# if only categ1, then colors for classes of categ1, if length(categ) == 2, then colors for classes of categ2*

**if(length(dot.color) == length(unique(data1[, categ[i0]]))){** *# here length(dot.color) is equal to the different number of categ*

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**data1 <- data.frame(data1, dot.color = data1[, categ[i0]])**

**levels(data1$dot.color) <- dot.color**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": IN ", categ[i0], " OF categ ARGUMENT, THE FOLLOWING COLORS:\n", paste(dot.color, collapse = " "), "\nHAVE BEEN ATTRIBUTED TO THESE CLASSES:\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(length(dot.color) == length(data1[, categ[i0]])){***# here length(dot.color) is equal to nrow(data1) -> Modif to have length(dot.color) equal to the different number of categ (length(dot.color) == length(levels(data1[, categ[i0]])))*

**data1 <- data.frame(data1, dot.color = dot.color)**

**}else if(length(dot.color) == 1 & ! all(dot.color == "same")){**

**data1[, categ[i0]] <- factor(data1[, categ[i0]])** *# if already a factor, change nothing, if characters, levels according to alphabetical order*

**data1 <- data.frame(data1, dot.color = dot.color)**

**dot.color <- rep(dot.color, length(levels(data1[, categ[i0]])))**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": dot.color ARGUMENT HAS LENGTH 1, MEANING THAT ALL THE DIFFERENT CLASSES OF ", categ[i0], "\n", paste(levels(factor(data1[, categ[i0]])), collapse = " "), "\nWILL HAVE THE SAME COLOR\n", paste(dot.color, collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": dot.color ARGUMENT MUST BE (1) LENGTH 1, OR (2) THE LENGTH OF data1 NROWS, OR (3) THE LENGTH OF THE CLASSES IN THE categ ", categ[i0], " COLUMN. HERE IT IS COLOR LENGTH ", length(dot.color), " VERSUS CATEG LENGTH ", length(data1[, categ[i0]]), " AND CATEG CLASS LENGTH ", length(unique(data1[, categ[i0]])), "\nPRESENCE OF NA COULD BE THE PROBLEM\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = dot.tidy, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dot.bin.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dot.jitter, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dot.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dot.border.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dot.alpha, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(ylim)){**

**tempo <- fun\_check(data = ylim, class = "vector", mode = "numeric", length = 2, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & any(ylim %in% c(Inf, -Inf))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ylim ARGUMENT CANNOT CONTAIN -Inf OR Inf VALUES\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = ylog, options = c("no", "log2", "log10"), length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ylog != "no"){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ylog ARGUMENT SET TO ", ylog, ".\nVALUES FROM THE y ARGUMENT COLUMN OF THE data1 DATA FRAME MUST BE ALREADY ", toupper(ylog), " TRANSFORMED, AS THE ylog ARGUMENT JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**if( ! is.null(ylim)){**

**if(any(ylim <= 0)){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ylim ARGUMENT CAN SPAN ZERO OR NEGATIVE VALUES IF ylog ARGUMENT IS SET TO ", ylog, " BECAUSE THIS LATTER ARGUMENT DOES NOT TRANSFORM DATA, JUST MODIFIES THE AXIS SCALE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(any( ! is.finite(if(ylog == "log10"){10^ylim}else{2^ylim}))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": ylim ARGUMENT RETURNS INF WITH THE ylog ARGUMENT SET TO ", ylog, "\nAS SCALE COMPUTATION IS ", ifelse(ylog == "log10", 10, 2), "^ylim:\n", paste(ifelse(ylog == "log10", 10, 2)^ylim, collapse = " "), "\nARE YOU SURE THAT ylim ARGUMENT HAS BEEN SPECIFIED WITH VALUES ALREADY IN LOG SCALE?\n", paste(ylim, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}**

**if( ! is.null(y.tick.nb)){**

**tempo <- fun\_check(data = y.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(y.inter.tick.nb)){**

**tempo <- fun\_check(data = y.inter.tick.nb, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.inter.tick.nb < 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": y.inter.tick.nb ARGUMENT MUST BE A NON NULL POSITIVE INTEGER\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = y.include.zero, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

*# inactivated because xlim and ylim already log transformed*

*# if(tempo$problem == FALSE & ylog != "no" & y.include.zero == TRUE){*

*# tempo.warning <- paste0("FROM FUNCTION ", function.name, ": ylog ARGUMENT SET TO ", ylog, " AND y.include.zero ARGUMENT SET TO TRUE -> y.include.zero ARGUMENT RESET TO FALSE BECAUSE NO 0 ALLOWED IN LOG SCALE")*

*# warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))*

*# }*

**tempo <- fun\_check(data = y.top.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.bottom.extra.margin, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(stat.disp)){**

**tempo <- fun\_check(data = stat.disp, options = c("top", "above"), length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = stat.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = stat.dist, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(xlab)){**

**if(all(class(xlab) %in% "expression")){** *# to deal with math symbols*

**tempo <- fun\_check(data = xlab, class = "expression", length = 1, fun.name = function.name) ; eval(ee)**

**}else{**

**tempo <- fun\_check(data = xlab, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**}**

**if( ! is.null(ylab)){**

**if(all(class(ylab) %in% "expression")){** *# to deal with math symbols*

**tempo <- fun\_check(data = ylab, class = "expression", length = 1, fun.name = function.name) ; eval(ee)**

**}else{**

**tempo <- fun\_check(data = ylab, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**}**

**tempo <- fun\_check(data = vertical, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ylog != "no" & vertical == FALSE){**

**vertical <- TRUE**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": BECAUSE OF A BUG IN ggplot2, CANNOT FLIP BARS HORIZONTALLY WITH A YLOG SCALE -> vertical ARGUMENT RESET TO TRUE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**tempo <- fun\_check(data = text.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title.text.size, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = text.angle, class = "vector", typeof = "integer", double.as.integer.allowed = TRUE, length = 1, neg.values = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = classic, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = grid, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = return, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = plot, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(add)){**

**tempo <- fun\_check(data = add, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! grepl(pattern = "^\\+", add)){** *# check that the add string start by +*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST START WITH \"+\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = "ggplot2::", add)){** *#*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST CONTAIN \"ggplot2::\" IN FRONT OF EACH GGPLOT2 FUNCTION: ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = ")$", add)){** *# check that the add string finished by )*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST FINISH BY \")\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking (and modification for proper color management)*

*# package checking*

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

**fun\_pack(req.package = c("scales"), path.lib = path.lib)**

*# end package checking*

*# main code*

**if(length(categ) == 1){**

*# new data frames for bar and error bars*

**mean.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]]) ; names(x.env) <-categ[1] ; x.env}, FUN = mean, na.rm = TRUE)**

**sd.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]]) ; names(x.env) <-categ[1] ; x.env}, FUN = sd, na.rm = TRUE)**

**nb.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]]) ; names(x.env) <- categ[1] ; x.env}, FUN = function(x.env2){length(x.env2[ ! is.na(x.env2)])})**

**if( ! all(identical(mean.dataframe[, categ[1]], sd.dataframe[, categ[1]]) & identical(mean.dataframe[, categ[1]], nb.dataframe[, categ[1]]))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": aggregate OUTPUT IS DIFFERENT IN TERM OF CLASS ORDER FOR mean.dataframe, sd.dataframe AND nb.dataframe. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**sem.dataframe <- sd.dataframe**

**sem.dataframe[, y] <- sd.dataframe[, y] / (nb.dataframe[, y])^0.5**

**}**

*# end new data frames for bar and error bars*

*# data1 check categ order for dots coordinates recovery*

**data1 <- data.frame(data1, categ.check = data1[, categ[1]])**

**data1$categ.check <- as.integer(data1$categ.check)** *# to check that data1[, categ[1]] and dot.coord$group are similar, during merging*

*# end data1 check categ order for dots coordinates recovery*

*# per bar dots coordinates recovery*

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot(data = data1, mapping = ggplot2::aes\_string(x = categ[1], y = y, fill = categ[1])))** *# fill because this is what is used with geom\_bar*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_point(stroke = dot.border.size, size = dot.size, alpha = dot.alpha, pch = 21))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_boxplot())** *# to easily have the equivalent of the grouped bars*

**dot.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$data[[1]]**

**if( ! is.null(dot.color)){**

**dot.coord <- data.frame(dot.coord[order(dot.coord$group, dot.coord$y), ], y.check = as.double(data1[order(data1$categ.check, data1[, y]), y]), categ.check = data1[order(data1$categ.check, data1[, y]), "categ.check"], dot.color = data1[order(data1$categ.check, data1[, y]), "dot.color"], tempo.categ1 = data1[order(data1$categ.check, data1[, y]), categ[1]])** *# y.check to be sure that the order is the same between the y of data1 and the y of dot.coord*

**names(dot.coord)[names(dot.coord) == "tempo.categ1"] <- categ[1]**

**if( ! identical(dot.coord$y, dot.coord$y.check)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": (dot.coord$y AND dot.coord$y.check) AS WELL AS (dot.coord$group AND dot.coord$categ.check) MUST BE IDENTICAL. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# end per bar dots coordinates recovery*

**}else if(length(categ) == 2){**

*# new data frames for bar and error bars*

**mean.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]], data1[, categ[2]]) ; names(x.env) <- c(categ[1], categ[2]) ; x.env}, FUN = mean, na.rm = TRUE)**

**sd.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]], data1[, categ[2]]) ; names(x.env) <- c(categ[1], categ[2]) ; x.env}, FUN = sd, na.rm = TRUE)**

**nb.dataframe <- aggregate(x = data1[y], by = {x.env <- list(data1[, categ[1]], data1[, categ[2]]) ; names(x.env) <- c(categ[1], categ[2]) ; x.env}, FUN = function(x.env2){length(x.env2[ ! is.na(x.env2)])})**

**tempo.check.mean <- mapply(FUN = "paste", mean.dataframe[, categ[1]], mean.dataframe[, categ[2]], sep = "\_")**

**tempo.check.sd <- mapply(FUN = "paste", sd.dataframe[, categ[1]], sd.dataframe[, categ[2]], sep = "\_")**

**tempo.check.nb <- mapply(FUN = "paste", nb.dataframe[, categ[1]], nb.dataframe[, categ[2]], sep = "\_")**

**if( ! all(identical(tempo.check.mean, tempo.check.sd) & identical(tempo.check.mean, tempo.check.nb))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": aggregate OUTPUT IS DIFFERENT IN TERM OF CLASS ORDER FOR mean.dataframe, sd.dataframe AND nb.dataframe. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**sem.dataframe <- sd.dataframe**

**sem.dataframe[, y] <- sd.dataframe[, y] / (nb.dataframe[, y])^0.5**

**}**

*# end new data frames for bar and error bars*

*# data1 check categ order for dots coordinates recovery*

**tempo.factor <- paste0(data1[order(data1[, categ[2]], data1[, categ[1]]), categ[2]], "\_", data1[order(data1[, categ[2]], data1[, categ[1]]), categ[1]])**

**data1 <- data.frame(data1[order(data1[, categ[2]], data1[, categ[1]]), ], categ.check = factor(tempo.factor, levels = unique(tempo.factor)))**

**data1$categ.check <- as.integer(data1$categ.check)**

*# end data1 check categ order for dots coordinates recovery*

*# per bar dots coordinates recovery*

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot(data = data1, mapping = ggplot2::aes\_string(x = categ[1], y = y, fill = categ[2])))** *# fill because this is what is used with geom\_bar*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_point(stroke = dot.border.size, size = dot.size, alpha = dot.alpha, pch = 21))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_boxplot())** *# to easily have the equivalent of the grouped bars*

**dot.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$data[[1]]**

**if( ! is.null(dot.color)){**

**dot.coord <- data.frame(dot.coord[order(dot.coord$group, dot.coord$y), ], y.check = as.double(data1[order(data1$categ.check, data1[, y]), y]), categ.check = data1[order(data1$categ.check, data1[, y]), "categ.check"], dot.color = data1[order(data1$categ.check, data1[, y]), "dot.color"], tempo.categ1 = data1[order(data1$categ.check, data1[, y]), categ[1]], tempo.categ2 = data1[order(data1$categ.check, data1[, y]), categ[2]])** *# y.check to be sure that the order is the same between the y of data1 and the y of dot.coord*

**names(dot.coord)[names(dot.coord) == "tempo.categ1"] <- categ[1]**

**names(dot.coord)[names(dot.coord) == "tempo.categ2"] <- categ[2]**

**if( ! (identical(dot.coord$y, dot.coord$y.check) & identical(dot.coord$group, dot.coord$categ.check))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": (dot.coord$y AND dot.coord$y.check) AS WELL AS (dot.coord$group AND dot.coord$categ.check) MUST BE IDENTICAL. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**data2 <- mean.dataframe**

**if( ! is.null(error.disp)){**

**if(error.disp == "SD"){**

**data2 <- data.frame(data2, SD = sd.dataframe[, y], ERROR.INF = mean.dataframe[, y] - sd.dataframe[, y], ERROR.SUP = mean.dataframe[, y] + sd.dataframe[, y])**

**}else if(error.disp == "SD.TOP"){**

**data2 <- data.frame(data2, SD = sd.dataframe[, y], ERROR.INF = mean.dataframe[, y], ERROR.SUP = mean.dataframe[, y] + sd.dataframe[, y])**

**}else if(error.disp == "SEM"){**

**data2 <- data.frame(data2, SEM = sem.dataframe[, y], ERROR.INF = mean.dataframe[, y] - sem.dataframe[, y], ERROR.SUP = mean.dataframe[, y] + sem.dataframe[, y])**

**}else if(error.disp == "SEM.TOP"){**

**data2 <- data.frame(data2, SEM = sem.dataframe[, y], ERROR.INF = mean.dataframe[, y], ERROR.SUP = mean.dataframe[, y] + sem.dataframe[, y])**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 3\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# stat output*

**stat <- data2**

**names(stat)[names(stat) == y] <- "MEAN"**

*# end stat output*

*# range depending on means and error bars*

**if(is.null(ylim)){**

**if(is.null(dot.color)){** *# no dots plotted*

**if( ! is.null(error.disp)){**

**if(any(c(data2[, "ERROR.INF"], data2[, "ERROR.SUP"]) %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data2 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE ERROR.INF OR ERROR.SUP COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**ylim <- range(c(data2[, "ERROR.INF"], data2[, "ERROR.SUP"]), na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}else{**

**if(any(data2[, y] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data2 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE y COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**ylim <- range(data2[, y], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**}else{**

**if(any(data2[, y] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data1 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE y COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**ylim <- range(data1[, y], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**}**

**if(suppressWarnings(all(ylim %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED YLIM CONTAINS Inf VALUES, BECAUSE VALUES FROM data2 ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end range depending on means and error bars*

**ylim.order <- order(ylim)** *# to deal with inverse axis*

**ylim <- sort(ylim)**

**ylim[1] <- ylim[1] - abs(ylim[2] - ylim[1]) \* ifelse(diff(ylim.order) > 0, y.bottom.extra.margin, y.top.extra.margin)** *# diff(ylim.order) > 0 means not inversed axis*

**ylim[2] <- ylim[2] + abs(ylim[2] - ylim[1]) \* ifelse(diff(ylim.order) > 0, y.top.extra.margin, y.bottom.extra.margin)** *# diff(ylim.order) > 0 means not inversed axis*

**if(y.include.zero == TRUE){** *# no need to check ylog != "no" because done before*

**ylim <- range(c(ylim, 0), na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**ylim <- ylim[ylim.order]**

**if(any(is.na(ylim))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 4\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# width commputations*

**if(length(categ) == 2){**

**bar.width2 <- bar.width / length(unique(data1[, categ[length(categ)]]))** *# real width of each bar in x-axis unit, among the set of grouped bar. Not relevant if no grouped bars length(categ) == 1*

**}else if(length(categ) == 1){**

**bar.width2 <- bar.width**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 5\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**error.whisker.width <- bar.width \* error.whisker.width** *# real error bar width*

**dot.jitter <- bar.width2 \* dot.jitter** *# real dot.jitter*

*# end width commputations*

*# barplot*

*# constant part*

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot())**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::xlab(if(is.null(xlab)){categ[1]}else{xlab}))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ylab(if(is.null(ylab)){y}else{ylab}))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggtitle(title))**

*# text angle management*

**tempo.just <- fun\_gg\_just(angle = text.angle, axis = ifelse(vertical == TRUE, "x", "y"))**

*# end text angle management*

**add.check <- TRUE**

**if( ! is.null(add)){** *# if add is NULL, then = 0*

**if(grepl(pattern = "ggplot2::theme", add) == TRUE){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": \"ggplot2::theme\" STRING DETECTED IN THE add ARGUMENT -> INTERNAL GGPLOT2 THEME FUNCTIONS theme() AND theme\_classic() HAVE BEEN INACTIVATED, TO BE USED BY THE USER")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**add.check <- FALSE**

**}**

**}**

**if(add.check == TRUE & classic == TRUE){**

*# BEWARE: not possible to add several times theme(). NO message but the last one overwrites the others*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::theme\_classic(base\_size = text.size))**

**if(grid == TRUE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),** *# draw lines for the y axis*

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),** *# draw lines for the x axis*

**panel.grid.major.x = if(vertical == TRUE){NULL}else{ggplot2::element\_line(colour = "grey75")},**

**panel.grid.major.y = if(vertical == TRUE){ggplot2::element\_line(colour = "grey75")}else{NULL},**

**axis.text.x = if(vertical == TRUE){ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}else{NULL},**

**axis.text.y = if(vertical == TRUE){NULL}else{ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}**

**))**

**}else{**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),**

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),**

**axis.text.x = if(vertical == TRUE){ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}else{NULL},**

**axis.text.y = if(vertical == TRUE){NULL}else{ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}**

**))**

**}**

**}else if(add.check == TRUE & classic == FALSE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_line(size = 0.5),**

**panel.background = ggplot2::element\_rect(fill = "grey95"),**

**axis.line.y.left = ggplot2::element\_line(colour = "black"),**

**axis.line.x.bottom = ggplot2::element\_line(colour = "black"),**

**panel.grid.major.x = ggplot2::element\_line(colour = "grey75"),**

**panel.grid.major.y = ggplot2::element\_line(colour = "grey75"),**

**panel.grid.minor.x = ggplot2::element\_blank(),**

**panel.grid.minor.y = ggplot2::element\_blank(),**

**strip.background = ggplot2::element\_rect(fill = "white", colour = "black"),**

**axis.text.x = if(vertical == TRUE){ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}else{NULL},**

**axis.text.y = if(vertical == TRUE){NULL}else{ggplot2::element\_text(angle = tempo.just$angle, hjust = tempo.just$hjust, vjust = tempo.just$vjust)}**

**))**

**}**

*# end constant part*

*# barplot and error bars*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_bar(data = data2, mapping = ggplot2::aes\_string(x = categ[1], y = y, fill = categ[length(categ)]), stat = "identity", position = ggplot2::position\_dodge(width = NULL), color = "black", width = bar.width))** *# stat = "identity" because already counted, position = position\_dodge(width = NULL) for grouped bars (width = NULL means no overlap between grouped bars). Please, see explanation in https://stackoverflow.com/questions/34889766/what-is-the-width-argument-in-position-dodge/35102486#35102486*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "fill", name = categ.legend.name, values = as.character(categ.color), guide = ggplot2::guide\_legend(override.aes = list(fill = categ.color))))** *# values are the values of color (which is the border color in geom\_bar. BEWARE: values = categ.color takes the numbers to make the colors if categ.color is a factor*

**if( ! is.null(error.disp)){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_errorbar(data = data2, mapping = ggplot2::aes\_string(x = categ[1], group = categ[length(categ)], ymin = "ERROR.INF", ymax = "ERROR.SUP"), position = ggplot2::position\_dodge(width = bar.width), color = "black", width = error.whisker.width))** *# cannot use fill = categ[length(categ)] because not an aesthetic of geom\_errorbar, but if only x = categ[1], wrong x coordinates with grouped bars*

**}**

*# end barplot and error bars*

*# coordinates management (for random plotting and for stat display)*

*# bars*

**bar.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$data[[1]]** *# to have the summary statistics of the plot. Here because can be required for stat.disp when just bar are plotted*

*# end bars*

**if( ! is.null(dot.color)){**

*# random dots*

**if(dot.tidy == FALSE){**

**dot.coord.rd1 <- merge(dot.coord, bar.coord[c("fill", "group", "x")], by = intersect("group", "group"), sort = FALSE)** *# rd for random. Send the coord of the bars into the coord data.frame of the dots (in the column x.y). BEWARE: by = intersect("group", "group") because group is enough as only one value of x per group number in bar.coord. Thus, no need to consider fill*

**if(nrow(dot.coord.rd1) != nrow(dot.coord)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE merge() FUNCTION DID NOT RETURN A CORRECT dot.coord.rd1 DATA FRAME. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**set.seed(1)**

**sampled.dot.jitter <- if(nrow(dot.coord.rd1) == 1){runif(n = nrow(dot.coord.rd1), min = - dot.jitter / 2, max = dot.jitter / 2)}else{sample(x = runif(n = nrow(dot.coord.rd1), min = - dot.jitter / 2, max = dot.jitter / 2), size = nrow(dot.coord.rd1), replace = FALSE)}**

**dot.coord.rd2 <- data.frame(dot.coord.rd1, dot.x = dot.coord.rd1$x.y + sampled.dot.jitter)** *# set the dot.jitter thanks to runif and dot.jitter range. Then, send the coord of the bars into the coord data.frame of the dots (in the column x.y)*

**set.seed(NULL)**

**if(length(categ) == 1){**

**tempo.data1 <- unique(data.frame(data1[categ[1]], group = as.integer(factor(as.numeric(data1[, categ[1]])))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**verif <- paste0(categ[1], ".check")**

**}else if(length(categ) == 2){**

**tempo.data1 <- unique(data.frame(data1[c(categ[1], categ[2])], group = as.integer(factor(paste0(as.numeric(data1[, categ[2]]), ".", as.numeric(data1[, categ[1]]))))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**names(tempo.data1)[names(tempo.data1) == categ[2]] <- paste0(categ[2], ".check")**

**verif <- c(paste0(categ[1], ".check"), paste0(categ[2], ".check"))**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 6\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**dot.coord.rd3 <- merge(dot.coord.rd2, tempo.data1, by = "group", sort = FALSE)** *# send the factors of data1 into coord*

**if(nrow(dot.coord.rd3) != nrow(dot.coord) | ( ! fun\_2d\_comp(dot.coord.rd3[categ], dot.coord.rd3[verif])$identical.content)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE merge() FUNCTION DID NOT RETURN A CORRECT dot.coord.rd3 DATA FRAME. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end random dots*

**}**

*# tidy dots*

*# coordinates are recover during plotting (see dot.coord.tidy1 below)*

*# end tidy dots*

**}**

*# end coordinates management (for random plotting and for stat display)*

*# dot display*

**if( ! is.null(dot.color)){**

**if(dot.tidy == FALSE){**

**if(dot.border.size == 0){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_point(data = dot.coord.rd3, mapping = ggplot2::aes\_string(x = "dot.x", y = "y", group = categ[length(categ)]), size = dot.size, color = dot.coord.rd3$dot.color, alpha = dot.alpha, pch = 16))** *# group used in aesthetic to do not have it in the legend. Here ggplot2::scale\_discrete\_manual() cannot be used because of the group easthetic*

**}else{**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_point(data = dot.coord.rd3, mapping = ggplot2::aes\_string(x = "dot.x", y = "y", group = categ[length(categ)]), stroke = dot.border.size, size = dot.size, fill = dot.coord.rd3$dot.color, alpha = dot.alpha, pch = 21))** *# group used in aesthetic to do not have it in the legend. Here ggplot2::scale\_discrete\_manual() cannot be used because of the group easthetic*

**}**

**}else if(dot.tidy == TRUE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_dotplot(data = dot.coord, mapping = ggplot2::aes\_string(x = categ[1], y = "y", color = categ[length(categ)]), position = ggplot2::position\_dodge(width = bar.width), binaxis = "y", stackdir = "center", alpha = dot.alpha, fill = dot.coord[rev(order(dot.coord[, categ[1]], decreasing = TRUE)), "dot.color"], show.legend = FALSE, binwidth = (ylim[2] - ylim[1]) / dot.bin.nb))** *# very weird behavior of geom\_dotplot, because data1 seems reorderer according to x = categ[1] before plotting. Thus, I have to use fill = dot.coord[rev(order(dot.coord[, categ[1]], decreasing = TRUE)), "dot.color"] to have the good corresponding colors # show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "color", name = categ.legend.name, values = if(dot.border.size == 0){as.character(levels(dot.coord[rev(order(dot.coord[, categ[1]], decreasing = TRUE)), "dot.color"]))}else{rep("black", length(categ.color))}))** *# values = rep("black", length(categ.color)) are the values of color (which is the border color of dots), and this modify the border color on the plot. BEWARE: values = categ.color takes the numbers to make the colors if categ.color is a factor. BEWARE: , guide = ggplot2::guide\_legend(override.aes = list(fill = levels(dot.color))) here*

*# coordinates of tidy dots*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$data** *# to have the tidy dot coordinates*

**if(length(which(sapply(tempo.coord, FUN = nrow) == nrow(data1))) > 1){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": MORE THAN 2 COMPARTMENT WITH NROW EQUAL TO nrow(data1) IN THE tempo.coord LIST (FOR TIDY DOT COORDINATES). CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}else{**

**dot.coord.tidy1 <- tempo.coord[[which(sapply(tempo.coord, FUN = nrow) == nrow(data1))]]**

**}**

**tempo.bar.coord <- merge(bar.coord, unique(dot.coord[, c("group", categ)]), by = intersect("group", "group"), sort = FALSE)** *# add the categ in bar.coord. BEWARE: by = intersect("group", "group") because group is enough as only one value of x per group number in bar.coord. Thus, no need to consider fill*

**if(nrow(tempo.bar.coord) != nrow(bar.coord)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE merge() FUNCTION DID NOT RETURN A CORRECT tempo.bar.coord DATA FRAME. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**dot.coord.tidy2 <- merge(dot.coord.tidy1, tempo.bar.coord[c("fill", "group", "x", categ)], by = intersect("group", "group"), sort = FALSE)** *# send the coord of the bars into the coord data.frame of the dots (in the column x.y). BEWARE: by = intersect("group", "group") because group is enough as only one value of x per group number in bar.coord. Thus, no need to consider fill*

**if(nrow(dot.coord.tidy2) != nrow(dot.coord)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE merge() FUNCTION DID NOT RETURN A CORRECT dot.coord.tidy2 DATA FRAME. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(categ) == 1){**

**tempo.data1 <- unique(data.frame(data1[categ[1]], group = as.integer(factor(as.numeric(data1[, categ[1]])))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**verif <- paste0(categ[1], ".check")**

**}else if(length(categ) == 2){**

**tempo.data1 <- unique(data.frame(data1[c(categ[1], categ[2])], group = as.integer(factor(paste0(as.numeric(data1[, categ[2]]), ".", as.numeric(data1[, categ[1]]))))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**names(tempo.data1)[names(tempo.data1) == categ[2]] <- paste0(categ[2], ".check")**

**verif <- c(paste0(categ[1], ".check"), paste0(categ[2], ".check"))**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 7\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**dot.coord.tidy3 <- merge(dot.coord.tidy2, tempo.data1, by = "group", sort = FALSE)** *# send the factors of data1 into coord*

**if(nrow(dot.coord.tidy3) != nrow(dot.coord) | ( ! fun\_2d\_comp(dot.coord.tidy3[categ], dot.coord.tidy3[verif])$identical.content)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE merge() FUNCTION DID NOT RETURN A CORRECT dot.coord.tidy3 DATA FRAME. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end coordinates of tidy dots*

**}**

**}**

*# end dot display*

*# stat display*

*# layer after dots but ok, behind dots on the plot*

**if( ! is.null(stat.disp)){**

**if(stat.disp == "top"){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "text", x = bar.coord$x, y = ylim[2], label = fun\_round(bar.coord$y, 2), size = stat.size, color = "black", hjust = ifelse(vertical == TRUE, 0.5, 1.1), vjust = ifelse(vertical == TRUE, 1.1, 0.5)))** *# beware: no need of order() for labels because bar.coord$x set the order. For justification, see https://stackoverflow.com/questions/7263849/what-do-hjust-and-vjust-do-when-making-a-plot-using-ggplot*

**}else if(stat.disp == "above"){**

*# stat coordinates*

**if( ! is.null(dot.color)){** *# for text just above max dot*

**if(dot.tidy == FALSE){**

**tempo.stat.ini <- dot.coord.rd3**

**}else if(dot.tidy == TRUE){**

**tempo.stat.ini <- dot.coord.tidy3**

**}**

**stat.coord1 <- aggregate(x = tempo.stat.ini["y"], by = {x.env <- if(length(categ) == 1){list(tempo.stat.ini$group, tempo.stat.ini$x.y, tempo.stat.ini[, categ[1]])}else if(length(categ) == 2){list(tempo.stat.ini$group, tempo.stat.ini$x.y, tempo.stat.ini[, categ[1]], tempo.stat.ini[, categ[2]])} ; names(x.env) <- if(length(categ) == 1){c("group", "x.y", categ[1])}else if(length(categ) == 2){c("group", "x.y", categ[1], categ[2])} ; x.env}, FUN = min, na.rm = TRUE)**

**names(stat.coord1)[names(stat.coord1) == "y"] <- "dot.min"**

**stat.coord2 <- aggregate(x = tempo.stat.ini["y"], by = {x.env <- if(length(categ) == 1){list(tempo.stat.ini$group, tempo.stat.ini$x.y, tempo.stat.ini[, categ[1]])}else if(length(categ) == 2){list(tempo.stat.ini$group, tempo.stat.ini$x.y, tempo.stat.ini[, categ[1]], tempo.stat.ini[, categ[2]])} ; names(x.env) <- if(length(categ) == 1){c("group", "x.y", categ[1])}else if(length(categ) == 2){c("group", "x.y", categ[1], categ[2])} ; x.env}, FUN = max, na.rm = TRUE)**

**names(stat.coord2) <- paste0(names(stat.coord2), "\_from.dot.max")**

**names(stat.coord2)[names(stat.coord2) == "y\_from.dot.max"] <- "dot.max"**

**stat.coord3 <- cbind(bar.coord[order(bar.coord$x), ], stat.coord1[order(stat.coord1$x.y), ], stat.coord2[order(stat.coord2$x.y), ])** *# should be ok to use bar.coord$x and stat.coord$x.y to assemble the two data frames because x coordinates of the bars. Thus, we cannot have identical values*

**if( ! all(identical(round(stat.coord3$x, 9), round(stat.coord3$x.y, 9)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": FUSION OF bar.coord, stat.coord1 AND stat.coord2 ACCORDING TO bar.coord$x, stat.coord1$x.y AND stat.coord2$x.y IS NOT CORRECT. CODE HAS TO BE MODIFIED\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**dot.text.coord <- stat.coord3[, c("x", "group", "dot.min", "dot.max")]**

**names(dot.text.coord)[names(dot.text.coord) == "dot.min"] <- "text.min.pos"**

**names(dot.text.coord)[names(dot.text.coord) == "dot.max"] <- "text.max.pos"**

**}**

**if( ! is.null(error.disp)){** *# for text just above error bars*

**if(length(categ) == 1){**

**tempo.data1 <- unique(data.frame(data1[categ[1]], group = as.integer(factor(as.numeric(data1[, categ[1]])))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**if( ! identical(stat[order(stat[, categ[1]]), categ[1]], tempo.data1[order(tempo.data1[, categ[1]]), categ[1]])){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE PROBLEM IN TRYING TO ASSEMBLE stat AND tempo.data1\n\n============\n\n"))**

**stop(tempo.cat)**

**}else{**

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**names(tempo.data1)[names(tempo.data1) == "group"] <- "group.check"**

**stat.coord4 <- cbind(stat[order(stat[, categ[1]]), ], tempo.data1[order(tempo.data1[, paste0(categ[1], ".check")]), ])**

**}**

**}else if(length(categ) == 2){**

**tempo.data1 <- unique(data.frame(data1[c(categ[1], categ[2])], group = as.integer(factor(paste0(as.numeric(data1[, categ[2]]), ".", as.numeric(data1[, categ[1]]))))))** *# categ[2] first if categ[2] is used to make the categories in ggplot and categ[1] is used to make the x-axis*

**if( ! fun\_2d\_comp(stat[order(stat[, categ[1]], stat[, categ[2]]), c(categ[1], categ[2])], tempo.data1[order(tempo.data1[, categ[1]], tempo.data1[, categ[2]]), c(categ[1], categ[2])])$identical.content){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE PROBLEM IN TRYING TO ASSEMBLE stat AND tempo.data1\n\n============\n\n"))**

**stop(tempo.cat)**

**}else{**

**names(tempo.data1)[names(tempo.data1) == categ[1]] <- paste0(categ[1], ".check")**

**names(tempo.data1)[names(tempo.data1) == categ[2]] <- paste0(categ[2], ".check")**

**names(tempo.data1)[names(tempo.data1) == "group"] <- "group.check"**

**stat.coord4 <- cbind(stat[order(stat[, categ[1]], stat[, categ[2]]), ], tempo.data1[order(tempo.data1[, paste0(categ[1], ".check")], tempo.data1[,paste0(categ[2], ".check")]), ])**

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 8\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if( ! identical(bar.coord$group[order(bar.coord$group)], stat.coord4$group.check[order(stat.coord4$group.check)])){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE PROBLEM IN TRYING TO ASSEMBLE bar.coord AND stat.coord4\n\n============\n\n"))**

**stop(tempo.cat)**

**}else{**

**stat.coord5 <- cbind(bar.coord[order(bar.coord$group), ], stat.coord4[order(stat.coord4$group.check), ])**

**error.text.coord <- stat.coord5[, c("x", "group", "ERROR.INF", "ERROR.SUP")] #**

**names(error.text.coord)[names(error.text.coord) == "ERROR.INF"] <- "text.min.pos"**

**names(error.text.coord)[names(error.text.coord) == "ERROR.SUP"] <- "text.max.pos"**

**}**

**}**

**if(( ! is.null(dot.color)) & ! is.null(error.disp)){** *# for text above max dot or error bar*

**stat.coord3 <- stat.coord3[order(stat.coord3$x), ]**

**stat.coord5 <- stat.coord5[order(stat.coord5$x), ]**

**if( ! identical(stat.coord3$group, stat.coord5$group)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE PROBLEM IN TRYING TO ASSEMBLE stat.coord3 AND stat.coord5\n\n============\n\n"))**

**stop(tempo.cat)**

**}else{**

**stat.coord6 <- data.frame(stat.coord3, min.dot.error = mapply(FUN = min, stat.coord3$dot.min, stat.coord5$ERROR.INF, na.rm = TRUE))**

**stat.coord7 <- data.frame(stat.coord6, max.dot.error = mapply(FUN = max, stat.coord3$dot.max, stat.coord5$ERROR.SUP, na.rm = TRUE))**

**both.text.coord <- stat.coord7[, c("x", "group", "min.dot.error", "max.dot.error")] #**

**names(both.text.coord)[names(both.text.coord) == "min.dot.error"] <- "text.min.pos"**

**names(both.text.coord)[names(both.text.coord) == "max.dot.error"] <- "text.max.pos"**

**}**

**}**

**if(( ! is.null(dot.color)) & is.null(error.disp)){**

**text.coord <- dot.text.coord**

**}else if(is.null(dot.color) & ! is.null(error.disp)){**

**text.coord <- error.text.coord**

**}else if(( ! is.null(dot.color)) & ! is.null(error.disp)){**

**text.coord <- both.text.coord**

**}**

**if( ! (is.null(dot.color) & is.null(error.disp))){**

**bar.coord <- bar.coord[order(bar.coord$x), ]**

**text.coord <- text.coord[order(text.coord$x), ]** *# to be sure to have the two objects in the same order for x. BEWARE: cannot add identical(as.integer(text.coord$group), as.integer(bar.coord$group)) because with error, the correspondence between x and group is not the same*

**if( ! identical(text.coord$x, bar.coord$x)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR: text.coord AND bar.coord DO NOT HAVE THE SAME x COLUMN CONTENT\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end stat coordinates*

*# stat display*

**if(is.null(dot.color) & is.null(error.disp)){** *# text just above bars*

*# performed twice: first for y values >=0, then y values < 0, because only a single value allowed for hjust anf vjust*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "text", x = bar.coord$x[bar.coord$y >= 0], y = bar.coord$y[bar.coord$y >= 0], label = fun\_round(bar.coord$y, 2)[bar.coord$y >= 0], size = stat.size, color = "black", hjust = ifelse(vertical == TRUE, 0.5, 0.5 - stat.dist), vjust = ifelse(vertical == TRUE, 0.5 - stat.dist, 0.5)))** *# beware: no need of order() for labels because bar.coord$x set the order*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "text", x = bar.coord$x[bar.coord$y < 0], y = bar.coord$y[bar.coord$y < 0], label = fun\_round(bar.coord$y, 2)[bar.coord$y < 0], size = stat.size, color = "black", hjust = ifelse(vertical == TRUE, 0.5, 0.5 + stat.dist), vjust = ifelse(vertical == TRUE, 0.5 + stat.dist, 0.5)))** *# beware: no need of order() for labels because bar.coord$x set the order*

**}else{** *# text just above error bars or dots*

*# I checked that text.coord and bar.coord have the same x and group column content. Thus, ok to use them together*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "text", x = text.coord$x[bar.coord$y >= 0], y = text.coord$text.max.pos[bar.coord$y >= 0], label = fun\_round(bar.coord$y, 2)[bar.coord$y >= 0], size = stat.size, color = "black", hjust = ifelse(vertical == TRUE, 0.5, 0.5 - stat.dist), vjust = ifelse(vertical == TRUE, 0.5 - stat.dist, 0.5)))** *# beware: no need of order() for labels because bar.coord$x set the order*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "text", x = text.coord$x[bar.coord$y < 0], y = text.coord$text.min.pos[bar.coord$y < 0], label = fun\_round(bar.coord$y, 2)[bar.coord$y < 0], size = stat.size, color = "black", hjust = ifelse(vertical == TRUE, 0.5, 0.5 + stat.dist), vjust = ifelse(vertical == TRUE, 0.5 + stat.dist, 0.5)))** *# beware: no need of order() for labels because bar.coord$x set the order*

**}**

*# end stat display*

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 9\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end stat display*

*# y scale management (cannot be before dot plot management)*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

**tempo.scale <- fun\_scale(lim = ylim, n = ifelse(is.null(y.tick.nb), length(tempo.coord$y.major\_source), y.tick.nb))**

*# for the ggplot2 bug with ylog, this does not work: eval(parse(text = ifelse(vertical == FALSE & ylog == "log10", "ggplot2::scale\_x\_continuous", "ggplot2::scale\_y\_continuous")))*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_y\_continuous(**

**breaks = tempo.scale,**

**labels = if(ylog == "log10"){scales::trans\_format("identity", scales::math\_format(10^.x))}else if(ylog == "log2"){scales::trans\_format("identity", scales::math\_format(2^.x))}else if(ylog == "no"){ggplot2::waiver()}else{tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 10\n\n============\n\n")) ; stop(tempo.cat)},**

**expand = c(0, 0),**

**limits = NA,**

**trans = ifelse(diff(ylim) < 0, "reverse", "identity")** *# equivalent to ggplot2::scale\_y\_reverse()*

**))**

**if(vertical == TRUE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::coord\_cartesian(ylim = ylim))** *# clip = "off" to have secondary ticks outside plot region does not work*

**}else{**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::coord\_flip(ylim = ylim))** *# clip = "off" to have secondary ticks outside plot region does not work*

**}**

*# secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

**tempo.coord <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))$layout$panel\_params[[1]]**

*# no secondary ticks for log2. Play with ylim*

**if(ylog == "log10"){**

**ylim.order <- order(ylim)** *# to deal with inverse axis*

**ini.scipen <- options()$scipen**

**options(scipen = -1000)** *# force scientific format*

**power10.exp <- as.integer(substring(text = 10^ylim, first = (regexpr(pattern = "\\+|\\-", text = 10^ylim))))** *# recover the power of 10. Example recover 08 from 1e+08*

**mantisse <- as.numeric(substr(x = 10^ylim, start = 1, stop = (regexpr(pattern = "\\+|\\-", text = 10^ylim) - 2)))** *# recover the mantisse. Example recover 1.22 from 1.22e+08*

**options(scipen = ini.scipen)** *# restore the initial scientific penalty*

**tempo.tick.pos <- as.vector(outer(log10(2:10), 10^((power10.exp[1] - ifelse(diff(ylim.order) > 0, 1, -1)):(power10.exp[2] + ifelse(diff(ylim.order) > 0, 1, -1)))))**

**tempo.tick.pos <- sort(tempo.tick.pos, decreasing = ifelse(diff(ylim.order) > 0, FALSE, TRUE))**

**tempo.tick.pos <- log10(tempo.tick.pos[tempo.tick.pos >= min(10^ylim) & tempo.tick.pos <= max(10^ylim)])**

**if(any(is.na(tempo.tick.pos) | ! is.finite(tempo.tick.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 11\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

*# if(vertical == TRUE){ # do not remove in case the bug is fixed*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", y = tempo.tick.pos, yend = tempo.tick.pos, x = tempo.coord$x.range[1], xend = tempo.coord$x.range[1] + diff(tempo.coord$x.range) / 80))**

*# }else{ # not working because of the ggplot2 bug*

*# assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", x = tempo.tick.pos, xend = tempo.tick.pos, y = tempo.coord$y.range[1], yend = tempo.coord$y.range[1] + diff(tempo.coord$y.range) / 80))*

*# }*

**}else if(( ! is.null(y.inter.tick.nb)) & ylog == "no"){**

**if(y.inter.tick.nb > 0){**

**if(vertical == TRUE){**

**ticks.pos <- suppressWarnings(as.numeric(tempo.coord$y.labels))** *# too difficult to predict the behavior of tempo.coord$x.major\_source depending on ylim neg or not, inv or not*

**if(any(is.na(ticks.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 12\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**tick.dist <- mean(diff(ticks.pos), na.rm = TRUE)**

**minor.tick.dist <- tick.dist / (y.inter.tick.nb + 1)**

**minor.tick.pos <- seq(ticks.pos[1] - tick.dist, ticks.pos[length(ticks.pos)] + tick.dist, by = minor.tick.dist)**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", y = minor.tick.pos, yend = minor.tick.pos, x = tempo.coord$x.range[1], xend = tempo.coord$x.range[1] + diff(tempo.coord$x.range) / 80))**

**}else{**

**ticks.pos <- suppressWarnings(as.numeric(tempo.coord$x.labels))***# too difficult to predict the behavior of tempo.coord$x.major\_source depending on ylim neg or not, inv or not*

**if(any(is.na(ticks.pos))){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 13\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**tick.dist <- mean(diff(ticks.pos), na.rm = TRUE)**

**minor.tick.dist <- tick.dist / (y.inter.tick.nb + 1)**

**minor.tick.pos <- seq(ticks.pos[1] - tick.dist, ticks.pos[length(ticks.pos)] + tick.dist, by = minor.tick.dist)**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::annotate(geom = "segment", y = minor.tick.pos, yend = minor.tick.pos, x = tempo.coord$y.range[1], xend = tempo.coord$y.range[1] + diff(tempo.coord$y.range) / 80))**

**}**

**}**

**}**

*# end secondary ticks (after ggplot2::coord\_cartesian() or ggplot2::coord\_flip())*

*# end y scale management (cannot be before dot plot management)*

**if(plot == TRUE){**

**suppressWarnings(print(eval(parse(text = paste(paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "), if(is.null(add)){NULL}else{add})))))**

**}else{**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": PLOT NOT SHOWN AS REQUESTED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

*# end barplot*

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**if(return == TRUE){**

**output <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))**

**output <- list(stat = stat, removed.row.nb = removed.row.nb, removed.rows = removed.rows, data = output$data, axes = output$layout$panel\_params[[1]], warnings = paste0("\n", warning, "\n\n"))**

**return(output)**

**}**

**}**

######## fun\_gg\_boxplot() #### ggplot2 boxplot + background dots if required

**# http://www.sthda.com/english/wiki/ggplot2-box-plot-quick-start-guide-r-software-and-data-visualization**

**# Example of boxplots: https://github.com/IndrajeetPatil/ggstatsplot**

**fun\_gg\_boxplot <- function(data1, y, categ, class.order = NULL, legend.name = NULL, categ.color = NULL, dot.color = "same", box.width = 0.5, whisker.width = 0.5, jitter = 0.25, ylim = NULL, ylog = FALSE, y.include.zero = FALSE, top.extra.margin = 0.05, bottom.extra.margin = 0, xlab = NULL, ylab = NULL, pt.size = 3, pt.border.size = 0.5, alpha = 0.5, show.stat = NULL, stat.size = 4, title = "", text.size = 12, break.nb = NULL, classic = FALSE, grid = FALSE, return = FALSE, path.lib = NULL){**

*# AIM*

*# ggplot2 vertical barplot representing mean values with the possibility to add error bars and to overlay dots*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# WARNINGS*

*# rows containing NA in data1[, c(y, categ)] will be removed before processing, with a warning (see below)*

*# to have a single boxplot, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped boxplots, create a factor column with a single class and specify this column in categ argument as first element (categ1). See categ below*

*# with several single boxplots (categ argument with only one element), bar.width argument (i.e., width argument of ggplot2::geom\_bar()) defines each bar width. The bar.width argument also defines the space between bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each bar)*

*# with several sets of grouped bars (categ argument with two elements), bar.width argument defines each set of grouped bar width. The bar.width argument also defines the space between set of grouped bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each set of grouped bar)*

*# ARGUMENTS*

*# data1: a dataframe containing one column of values (see y argument below) and one or two columns of categories (see categ argument below)*

*# y: character string of the data1 column name for y-axis (containing numeric values). Numeric values will be used to generate the boxplots and will also be used to plot the dots*

*# categ: vector of character strings of the data1 column name for categories (column of characters or factor). Must either be one or two column names. If a single column name (further refered to as categ1), then one boxplot per class of categ1. If two column names (further refered to as categ1 and categ2), then one boxplot per class of categ2, which form a group of boxplots in each class of categ1. BEWARE, categ1 (and categ2 if it exists) must have a single value of y per class of categ1 (and categ2). To have a single boxplot, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped boxplots, create a factor column with a single class and specify this column in categ argument as first element (categ1)*

*# class.order: list indicating the order of the classes of categ1 and categ2 represented on the boxplot (the first compartment for categ1 and and the second for categ2). If class.order = NULL, classes are represented according to the alphabetical order. Some compartment can be NULL and other not*

*# legend.name: character string of the legend title for categ2. If legend.name = NULL, then legend.name <- categ1 if only categ1 is present and legend.name <- categ2 if categ1 and categ2 are present. Write "" if no legend required*

*# categ.color: vector of character color string for boxplot color. If categ.color = NULL, default colors of ggplot2, whatever categ1 and categ2. If categ.color is non null and only categ1 in categ argument, categ.color can be either: (1) a single color string (all the boxplots will have this color, whatever the classes of categ1), (2) a vector of string colors, one for each class of categ1 (each color will be associated according to class.order of categ1), (3) a vector or factor of string colors, like if it was one of the column of data1 data frame (beware: a single color per class of categ1 and a single class of categ1 per color must be respected). Integers are also accepted instead of character strings, as long as above rules about length are respected. Integers will be processed by fun\_gg\_palette() using the max integer value among all the integers in categ.color. If categ.color is non null and categ1 and categ2 specified, all the rules described above will apply to categ2 instead of categ1 (colors will be determined for boxplots inside a group of boxplots)*

*# dot.color: vector of character string. Idem as categ.color but for dots, except that in the possibility (3), the rule "a single color per class of categ1 and a single class of categ1", cannot be respected (each dot can have a different color). If NULL, no dots plotted*

*# box.width: numeric value (from 0 to 1) of the bar or set of grouped bar width (see warnings above)*

*# whisker.width: numeric value (from 0 to 1) of the whisker (error bar extremities) width, with 0 meaning no whiskers and 1 meaning a width equal to the corresponding bar width*

*# jitter: numeric value (from 0 to 1) of random dot horizontal dispersion, with 0 meaning no dispersion and 1 meaning a dispersion in the corresponding bar width interval*

*# ylim: 2 numeric values for y-axis range. If NULL, range of y in data1*

*# ylog: logical. Log scale for the y-axis? BEWARE: do not tranform the data, but just display ticks in a log scale manner. BEWARE: if TRUE, ylim must not contain null or negative values*

*# y.include.zero: logical. Does ylim range include 0? BEWARE: if ylog = TRUE, will be automately set to FALSE with a warning message*

*# top.extra.margin: single proportion (between 0 and 1) indicating if extra margins must be added to ylim. If different from 0, add the range of the axis \* top.extra.margin (e.g., abs(ylim[2] - ylim[1]) \* top.extra.margin) to the top of y-axis. BEWARE with ylog = TRUE, the range result must not overlap zero or negative values*

*# bottom.extra.margin: idem as top.extra.margin but to the bottom of y-axis*

*# xlab: a character string for x-axis legend. If NULL, character string of categ1*

*# ylab: a character string y-axis legend. If NULL, character string of the y argument*

*# pt.size: numeric value of dot size*

*# pt.border.size: numeric value of border dot size. Write zero for no stroke*

*# alpha: numeric value (from 0 to 1) of dot transparency (full transparent to full opaque, respectively)*

*# show.stat: add the mean number above the corresponding bar. Either NULL (no number shown), "top" (at the top of the figure region) or "above" (above each bar)*

*# stat.size: numeric value of the number size (in points)*

*# title: character string of the graph title*

*# text.size: numeric value of the text size (in points)*

*# break.nb: number of desired values on the y-axis*

*# classic: logical. Use the classic theme (article like)?*

*# grid: logical. draw horizontal lines in the background to better read the boxplot values? Not considered if classic = FALSE*

*# return: logical. Return the graph parameters?*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# fun\_gg\_palette()*

*# fun\_round()*

*# fun\_2d\_comp()*

*# RETURN*

*# a boxplot*

*# a list of the graph info if return argument is TRUE:*

*# $stat: the graphic statistics*

*# $removed.row.nb: which rows have been removed due to NA detection in y and categ columns (NULL if no row removed)*

*# $removed.rows: removed rows containing NA (NULL if no row removed)*

*# $data: the graphic info coordinates*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", categ.color = "white") # separate bars, modification of bar color 1 (a single value)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", categ.color = c("red", "blue")) # separate bars, modification of bar color 2 (one value par class of categ2)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), bar.color = rep(c("brown", "orange"), time = 10)) ; obs1 ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", categ.color = obs1$bar.color) # separate bars, modification of bar color 3 (one value per line of obs1, with respect of the correspondence between categ2 and bar.color columns)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = "same") # separate bars, modification of dot color 1 (same dot color as the corresponding bar)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = "green") # separate bars, modification of dot color 2 (single color for all the dots)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = c("green", "brown")) # separate bars, modification of dot color 3 (one value par class of categ2)*

*# obs1 <- data.frame(a = 1:10, group1 = rep(c("G", "H"), times = 5)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = hsv(h = (1:nrow(obs1)) / nrow(obs1))) # separate bars, modification of dot color 4 (any color for each dot)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2")) # grouped bars, default arguments*

*# obs1 <- data.frame(a = 1:24, group1 = rep(c("G", "H"), times = 12), group2 = rep(c("A", "B", "C", "D"), each = 6)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), return = TRUE) # more grouped bars*

*# obs1 <- data.frame(a = log10((1:20) \* 100), group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), ylog = TRUE) # grouped bars, log scale. BEWARE, y column must be log, otherwise incoherent scale*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = NULL) # grouped bars, no dots*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), categ.color = "white") # grouped bars, modification of bar color 1 (a single value)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), categ.color = c("red", "blue")) # grouped bars, modification of bar color 2 (one value par class of categ2)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("brown", "orange"), each = 10)) ; obs1 ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), categ.color = obs1$bar.color) # grouped bars, modification of bar color 3 (one value per line of obs1, with respect of the correspondence between categ2 and bar.color columns)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = "same") # grouped bars, modification of dot color 1 (same dot color as the corresponding bar)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = "green") # grouped bars, modification of dot color 2 (single color for all the dots)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = c("green", "brown")) # grouped bars, modification of dot color 3 (one value par class of categ2)*

*# obs1 <- data.frame(a = 1:10, group1 = rep(c("G", "H"), times = 5), group2 = rep(c("A", "B"), each = 5)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = hsv(h = (1:nrow(obs1)) / nrow(obs1))) # grouped bars, modification of dot color 4 (any color for each dot)*

*# obs1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), class.order = list(NULL, c("B", "A")), legend.name = "", categ.color = c("red", "blue"), dot.color = "grey", error.bar = "SD", bar.width = 0.25, error.bar.width = 0.8, jitter = 1, ylim = c(10, 30), y.include.zero = FALSE, top.extra.margin = 0.5, bottom.extra.margin = 1, xlab = "GROUP", ylab = "MEAN", pt.size = 4, pt.border.size = 0, alpha = 1, show.stat = "above", stat.size = 4, title = "GRAPH1", text.size = 20, return = TRUE, break.nb = 10, classic = TRUE, grid = TRUE) # grouped bars, all the arguments*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = NULL, bar.width = 0.25) # width example. With bar.width = 0.25, three times more space between single bars than the bar width*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = "group1", dot.color = NULL, bar.width = 1) # width example. With bar.width = 1, no space between single bars*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = NULL, bar.width = 0.25) # width example. With bar.width = 0.25, three times more space between sets of grouped bars than the set width*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = NULL, bar.width = 1) # width example. With bar.width = 0, no space between sets of grouped bars*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = NULL, error.bar = "SD", error.bar.width = 1) # width example. With error.bar.width = 1, whiskers have the width of the corresponding bar*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = NULL, error.bar = "SD", error.bar.width = 0) # width example. No whiskers*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = "grey", pt.size = 3, alpha = 1, jitter = 1) # width example. With jitter = 1, dispersion around the corresponding bar width*

*# obs1 <- data.frame(a = 1:1000, group1 = rep(c("G", "H"), times = 500), group2 = rep(LETTERS[1:5], each = 200)) ; fun\_gg\_bar\_mean(data1 = obs1, y = "a", categ = c("group1", "group2"), dot.color = "grey", pt.size = 3, alpha = 1, jitter = 0) # width example. No dispersion*

*# DEBUGGING*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10)) ; y = names(data1)[1] ; categ = names(data1)[2] ; class.order = list(L1 = NULL) ; legend.name = NULL ; categ.color = c("red", "blue") ; dot.color = "same" ; error.bar = "SEM.TOP" ; bar.width = 0.5 ; error.bar.width = 0.5 ; jitter = 0.25 ; ylim = NULL ; ylog = FALSE ; y.include.zero = FALSE ; top.extra.margin = 0.05 ; bottom.extra.margin = 0 ; xlab = NULL ; ylab = NULL ; pt.size = 3 ; pt.border.size = 0.1 ; alpha = 1 ; show.stat = NULL ; stat.size = 8 ; title = "GRAPH1" ; text.size = 12 ; text.angle = 0 ; return = FALSE ; break.nb = NULL ; classic = FALSE ; grid = FALSE ; path.lib = NULL*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; class.order = list(L1 = NULL, L2 = c("B", "A")) ; legend.name = NULL ; categ.color = c("red", "blue") ; dot.color = "same" ; error.bar = "SEM.TOP" ; bar.width = 0.5 ; error.bar.width = 0.5 ; jitter = 0.25 ; ylim = NULL ; ylog = FALSE ; y.include.zero = FALSE ; top.extra.margin = 0.05 ; bottom.extra.margin = 0 ; xlab = NULL ; ylab = NULL ; pt.size = 3 ; pt.border.size = 0.1 ; alpha = 1 ; show.stat = NULL ; stat.size = 8 ; title = "GRAPH1" ; text.size = 12 ; text.angle = 0 ; return = FALSE ; break.nb = NULL ; classic = FALSE ; grid = FALSE ; path.lib = NULL*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10)) ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; class.order = list(L1 = NULL, L2 = c("B", "A")) ; legend.name = NULL ; categ.color = NULL ; dot.color = "same" ; error.bar = NULL ; bar.width = 0.5 ; error.bar.width = 0.5 ; jitter = 0.25 ; ylim = NULL ; ylog = TRUE ; y.include.zero = FALSE ; top.extra.margin = 0.05 ; bottom.extra.margin = 0 ; xlab = NULL ; ylab = NULL ; pt.size = 3 ; pt.border.size = 0.1 ; alpha = 0.5 ; show.stat = NULL ; stat.size = 8 ; title = "" ; text.size = 12 ; text.angle = 0 ; return = FALSE ; break.nb = NULL ; classic = FALSE ; grid = FALSE ; path.lib = NULL*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("brown", "orange"), each = 10)) ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; class.order = list(L1 = NULL, L2 = c("B", "A")) ; legend.name = NULL ; categ.color = data1$bar.color ; dot.color = "same" ; error.bar = "SD" ; bar.width = 0.5 ; error.bar.width = 0.5 ; jitter = 0.25 ; ylim = NULL ; ylog = TRUE ; y.include.zero = FALSE ; top.extra.margin = 0.05 ; bottom.extra.margin = 0 ; xlab = NULL ; ylab = NULL ; pt.size = 3 ; pt.border.size = 0.1 ; alpha = 0.5 ; show.stat = NULL ; stat.size = 8 ; title = "" ; text.size = 12 ; text.angle = 0 ; return = FALSE ; break.nb = NULL ; classic = FALSE ; grid = FALSE ; path.lib = NULL*

*# data1 <- data.frame(a = 1:20, group1 = rep(c("G", "H"), times = 10), group2 = rep(c("A", "B"), each = 10), bar.color = rep(c("brown", "orange"), each = 10)) ; data1[2:3, 1] <- NA ; data1[7:8, 2] <- NA ; y = names(data1)[1] ; categ = c(names(data1)[2], names(data1)[3]) ; class.order = list(L1 = NULL, L2 = c("B", "A")) ; legend.name = NULL ; categ.color = na.omit(data1)$bar.color ; dot.color = "same" ; error.bar = "SD" ; bar.width = 0.5 ; error.bar.width = 0.5 ; jitter = 0.25 ; ylim = NULL ; ylog = TRUE ; y.include.zero = FALSE ; top.extra.margin = 0.05 ; bottom.extra.margin = 0 ; xlab = NULL ; ylab = NULL ; pt.size = 3 ; pt.border.size = 0.1 ; alpha = 0.5 ; show.stat = "above" ; stat.size = 4 ; title = "" ; text.size = 12 ; text.angle = 0 ; return = FALSE ; break.nb = NULL ; classic = FALSE ; grid = FALSE ; path.lib = NULL*

*# function name*

**}**

######## fun\_gg\_bar\_prop() #### ggplot2 proportion barplot

######## fun\_gg\_strip() #### ggplot2 stripchart + mean/median

######## fun\_gg\_violin() #### ggplot2 violins

######## fun\_gg\_line() #### ggplot2 lines + background dots and error bars

**# DO NOT ERASE. COMPARE WITH BAR MEAN BEFORE AND RECOVER WHAT HAS BEEN MODIFIED**

**fun\_gg\_line <- function(data1, y, categ, categ.class.order = NULL, categ.legend.name = NULL, categ.color = NULL, line.size = 1, error.disp = NULL, error.whisker.width = 0.5, dot.color = "same", dot.tidy = FALSE, dot.bin.nb = 30, dot.jitter = 0.25, dot.size = 3, dot.border.size = 0.5, dot.alpha = 0.5, ylim = NULL, ylog = FALSE, y.tick.nb = NULL, y.include.zero = FALSE, y.top.extra.margin = 0.05, y.bottom.extra.margin = 0, stat.disp = NULL, stat.size = 4, stat.dist = 2, xlab = NULL, ylab = NULL, vertical = TRUE, title = "", text.size = 12, text.angle = 0, classic = FALSE, grid = FALSE, return = FALSE, path.lib = NULL){**

*# AIM*

*# ggplot2 vertical barplot representing mean values with the possibility to add error bars and to overlay dots*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# WARNINGS*

*# rows containing NA in data1[, c(y, categ)] will be removed before processing, with a warning (see below)*

*# if ever bars disappear, see the end of https://github.com/tidyverse/ggplot2/issues/2887*

*# to have a single bar, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped bars, create a factor column with a single class and specify this column in categ argument as first element (categ1). See categ below*

*# with several single bars (categ argument with only one element), bar.width argument (i.e., width argument of ggplot2::geom\_bar()) defines each bar width. The bar.width argument also defines the space between bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each bar)*

*# with several sets of grouped bars (categ argument with two elements), bar.width argument defines each set of grouped bar width. The bar.width argument also defines the space between set of grouped bars by using (1 - bar.width). In addition, xmin and xmax of the fun\_gg\_bar\_mean() output report the bar boundaries (around x-axis unit 1, 2, 3, etc., for each set of grouped bar)*

*# to manually change the 0 base bar into this code, see https://stackoverflow.com/questions/35324892/ggplot2-setting-geom-bar-baseline-to-1-instead-of-zero*

*# ARGUMENTS*

*# data1: a dataframe containing one column of values (see y argument below) and one or two columns of categories (see categ argument below). Duplicated column names not allowed*

*# y: character string of the data1 column name for y-axis (containing numeric values). Numeric values will be averaged by categ to generate the bars and will also be used to plot the dots*

*# categ: vector of character strings of the data1 column name for categories (column of characters or factor). Must either be one or two column names. If a single column name (further refered to as categ1), then one bar per class of categ1. If two column names (further refered to as categ1 and categ2), then one bar per class of categ2, which form a group of bars in each class of categ1. BEWARE, categ1 (and categ2 if it exists) must have a single value of y per class of categ1 (and categ2). To have a single bar, create a factor column with a single class and specify the name of this column in categ argument as unique element (no categ2 in categ argument). For a single set of grouped bars, create a factor column with a single class and specify this column in categ argument as first element (categ1)*

*# categ.class.order: list indicating the order of the classes of categ1 and categ2 represented on the barplot (the first compartment for categ1 and and the second for categ2). If categ.class.order = NULL, classes are represented according to the alphabetical order. Some compartment can be NULL and other not*

*# categ.legend.name: character string of the legend title for categ2. If categ.legend.name = NULL, then categ.legend.name <- categ1 if only categ1 is present and categ.legend.name <- categ2 if categ1 and categ2 are present. Write "" if no legend required*

*# categ.color: vector of character color string for bar filling. If categ.color = NULL, default colors of ggplot2, whatever categ1 and categ2. If categ.color is non null and only categ1 in categ argument, categ.color can be either: (1) a single color string (all the bars will have this color, whatever the classes of categ1), (2) a vector of string colors, one for each class of categ1 (each color will be associated according to categ.class.order of categ1), (3) a vector or factor of string colors, like if it was one of the column of data1 data frame (beware: a single color per class of categ1 and a single class of categ1 per color must be respected). Integers are also accepted instead of character strings, as long as above rules about length are respected. Integers will be processed by fun\_gg\_palette() using the max integer value among all the integers in categ.color. If categ.color is non null and categ1 and categ2 specified, all the rules described above will apply to categ2 instead of categ1 (colors will be determined for bars inside a group of bars)*

*# bar.width: numeric value (from 0 to 1) of the bar or set of grouped bar width (see warnings above)*

*# error.disp: either "SD", "SD.TOP", "SEM" or "SEM.TOP". If NULL, no error bars added*

*# error.whisker.width: numeric value (from 0 to 1) of the whisker (error bar extremities) width, with 0 meaning no whiskers and 1 meaning a width equal to the corresponding bar width*

*# dot.color: vector of character string. Idem as categ.color but for dots, except that in the possibility (3), the rule "a single color per class of categ1 and a single class of categ1", cannot be respected (each dot can have a different color). If NULL, no dots plotted*

*# dot.tidy: logical. Nice dot spreading? If TRUE, use the geom\_dotplot() function for a nice representation. If FALSE, dots are randomly spread, using the dot.jitter argument (see below)*

*# dot.bin.nb: positive integer indicating the number of bins (i.e., nb of separations) of the ylim range. Each dot will then be put in one of the bin, with the size the width of the bin. Not considered if dot.tidy is FALSE*

*# dot.jitter: numeric value (from 0 to 1) of random dot horizontal dispersion, with 0 meaning no dispersion and 1 meaning a dispersion in the corresponding bar width interval. Not considered if dot.tidy is TRUE*

*# dot.size: numeric value of dot size. Not considered if dot.tidy is TRUE*

*# dot.border.size: numeric value of border dot size. Write zero for no dot border. If dot.tidy is TRUE, value 0 remove the border. Another one leave the border without size control (geom\_doplot() feature)*

*# dot.alpha: numeric value (from 0 to 1) of dot transparency (full transparent to full opaque, respectively)*

*# ylim: 2 numeric values for y-axis range. If NULL, range of y in data1*

*# ylog: logical. Log scale for the y-axis? BEWARE: do not tranform the data, but just display ticks in a log scale manner. BEWARE: if TRUE, ylim must not contain null or negative values. In addition, will be automatically set to FALSE if vertical argument is set to FALSE, to prevent a bug in ggplot2 (see https://github.com/tidyverse/ggplot2/issues/881)*

*# y.tick.nb: number of desired values on the y-axis*

*# y.include.zero: logical. Does ylim range include 0? BEWARE: if ylog = TRUE, will be automately set to FALSE with a warning message*

*# y.top.extra.margin: single proportion (between 0 and 1) indicating if extra margins must be added to ylim. If different from 0, add the range of the axis \* y.top.extra.margin (e.g., abs(ylim[2] - ylim[1]) \* y.top.extra.margin) to the top of y-axis. BEWARE with ylog = TRUE, the range result must not overlap zero or negative values*

*# y.bottom.extra.margin: idem as y.top.extra.margin but to the bottom of y-axis*

*# stat.disp: add the mean number above the corresponding bar. Either NULL (no number shown), "top" (at the top of the figure region) or "above" (above each bar)*

*# stat.size: numeric value of the stat size (in points). Increase the value to increase text size*

*# stat.dist: numeric value of the stat distance. Increase the value to increase the distance*

*# xlab: a character string for x-axis legend. If NULL, character string of categ1*

*# ylab: a character string y-axis legend. If NULL, character string of the y argument*

*# vertical: logical. Vertical bars? BEWARE: cannot have horizontal bars with a log axis, i.e., ylog = TRUE & vertical = FALSE (see ylog above)*

*# title: character string of the graph title*

*# text.size: numeric value of the text size (in points)*

*# text.angle: integer value of the text angle for the x-axis labels. Positive values for counterclockwise rotation: 0 for horizontal, 90 for vertical, 180 for upside down etc. Negative values for clockwise rotation: 0 for horizontal, -90 for vertical, -180 for upside down etc.*

*# classic: logical. Use the classic theme (article like)?*

*# grid: logical. draw horizontal lines in the background to better read the bar values? Not considered if classic = FALSE*

*# return: logical. Return the graph parameters?*

*# path.lib: absolute path of the required packages, if not in the default folders*

**}**

######## fun\_gg\_heatmap() #### ggplot2 heatmap + overlaid mask if required

**#test plot.margin = margin(up.space.mds, right.space.mds, down.space.mds, left.space.mds, "inches") to set the dim of the region plot ?**

**# Check OK: clear to go Apollo**

**fun\_gg\_heatmap <- function(data1, legend.name1 = "", low.color1 = "blue", mid.color1 = "white", high.color1 = "red", limit1 = NULL, midpoint1 = NULL, data2 = NULL, color2 = "black", alpha2 = 0.5, invert2 = FALSE, text.size = 12, title = "", title.text.size = 12, show.scale = TRUE, rotate = FALSE, return = FALSE, plot = TRUE, add = NULL, warn.print = FALSE, path.lib = NULL){**

*# AIM*

*# ggplot2 heatmap with the possibility to overlay a mask*

*# see also:*

*# draw : http://www.sthda.com/english/wiki/ggplot2-quick-correlation-matrix-heatmap-r-software-and-data-visualization*

*# same range scale : https://stackoverflow.com/questions/44655723/r-ggplot2-heatmap-fixed-scale-color-between-graphs*

*# for ggplot2 specifications, see: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html*

*# ARGUMENTS*

*# data1: numeric matrix or data frame resulting from the conversion of the numeric matrix by reshape2::melt()*

*# legend.name1: character string of the data1 heatmap scale legend*

*# low.color1: character string of the color (i.e., "blue" or "#0000FF") of the lowest scale value*

*# mid.color1: same as low.color1 but for the middle scale value. If NULL, the middle color is the default color between low.color1 and high.color1. BEWARE: argument midpoint1 is not ignored, even if mid.color1 is NULL, meaning that the default mid color can still be controled*

*# high.color1: same as low.color1 but for the highest scale value*

*# limit1: 2 numeric values defining the lowest and higest color scale values. If NULL, take the range of data1 values*

*# midpoint1: single numeric value defining the value corresponding to the mid.color1 argument. A warning message is returned if midpoint1 does not correspond to the mean of limit1 values, because the color scale is not linear anymore. If NULL, takes the mean of limit1 values. Mean of data1, instead of mean of limit1, can be used here if required*

*# data2: binary mask matrix (made of 0 and 1) of same dimension as data1 or a data frame resulting from the conversion of the binary mask matrix by reshape2::melt(). Value 1 of data2 will correspond to color2 argument (value 0 will be NA color), and the opposite if invert2 argument is TRUE (inverted mask)*

*# color2: color of the 1 values of the binary mask matrix. The 0 values will be color NA*

*# alpha2: numeric value (from 0 to 1) of the mask transparency*

*# invert2: logical. Invert the mask (1 -> 0 and 0 -> 1)?*

*# text.size: numeric value of the size of the texts in scale*

*# title: character string of the graph title*

*# title.text.size: numeric value of the title size (in points)*

*# show.scale: logical. Show color scale?*

*# rotate: logical. Rotate the heatmap 90° clockwise?*

*# return: logical. Return the graph parameters?*

*# plot: logical. Plot the graphic? If FALSE and return argument is TRUE, graphical parameters and associated warnings are provided without plotting*

*# add: character string allowing to add more ggplot2 features (dots, lines, themes, etc.). BEWARE: (1) must start with "+" just after the simple or double opening quote (no space, end of line, carriage return, etc., allowed), (2) must finish with ")" just before the simple or double closing quote (no space, end of line, carriage return, etc., allowed) and (3) each function must be preceded by "ggplot2::" (for instance: "ggplot2::coord\_flip()). If the character string contains the "ggplot2::theme" string, then internal ggplot2 theme() and theme\_classic() functions will be inactivated to be reused by add. BEWARE: handle this argument with caution since added functions can create conflicts with the preexisting internal ggplot2 functions*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# reshape2*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# fun\_round()*

*# RETURN*

*# a heatmap if plot argument is TRUE*

*# a list of the graph info if return argument is TRUE:*

*# $data: a list of the graphic info*

*# $axes: a list of the axes info*

*# $scale: the scale info (lowest, mid and highest values)*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# fun\_gg\_heatmap(data1 = matrix(1:16, ncol = 4), title = "GRAPH 1")*

*# fun\_gg\_heatmap(data1 = matrix(1:16, ncol = 4), return = TRUE)*

*# fun\_gg\_heatmap(data1 = matrix(1:16, ncol = 4), legend.name1 = "VALUE", title = "GRAPH 1", text.size = 5, data2 = matrix(rep(c(1,0,0,0), 4), ncol = 4), invert2 = FALSE, return = TRUE)*

*# diagonal matrix*

*# fun\_gg\_heatmap(data1 = matrix(c(1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1), ncol = 4))*

*# fun\_gg\_heatmap(data1 = reshape2::melt(matrix(c(1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1), ncol = 4)))*

*# error message*

*# fun\_gg\_heatmap(data1 = matrix(1:16, ncol = 4), data2 = matrix(rep(c(1,0,0,0), 5), ncol = 5))*

*# fun\_gg\_heatmap(data1 = matrix(1:16, ncol = 4), data2 = reshape2::melt(matrix(rep(c(1,0,0,0), 4), ncol = 4)))*

*# fun\_gg\_heatmap(data1 = reshape2::melt(matrix(1:16, ncol = 4)), data2 = reshape2::melt(matrix(rep(c(1,0,0,0), 4), ncol = 4)))*

*#### NICE REPRESENTATION*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 10, 3), time = rnorm(1000, 10, 3), group1 = rep(c("A1", "A2"), 500)) ; obs2 <-data.frame(km = rnorm(1000, 15, 3), time = rnorm(1000, 15, 3), group2 = rep(c("G1", "G2"), 500)) ; set.seed(NULL) ; obs1$L1$km[2:3] <- NA ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = NULL, color = list(L1 = 4:5, L2 = 7:8), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), dot.size = 3, line.size = 0.5, xlim = c(1, 25), xlab = "KM", xlog = "no", x.tick.nb = 10, x.inter.tick.nb = 1, x.left.extra.margin = 0, x.right.extra.margin = 0, ylim = c(1, 25), ylab = expression(paste("TIME (", 10^-20, " s)")), ylog = "log10", y.tick.nb = 5, y.top.extra.margin = 0, y.bottom.extra.margin = 0, xy.include.zero = TRUE, classic = TRUE)*

*#### SINGLE GEOMETRIC LAYER*

*# simple example (1) of scatter plot using the classical writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time")*

*# simple example (2) of scatter plot, identical to (1) but using the list writting. Here, a list of one compartment, systematically named L1, is provided to the data1, x, y, categ, geom and alpha. Contrary to example (1), the geom and alpha argument have to be included because the default value are not lists (if data1 is a list, all the x, y, categ, legend.name, color, geom and alpha must also be list if non NULL)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 0.5))*

*# color of dots. Example (1) using the classical writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", color = "blue")*

*# color of dots. Example (2) using the list writting*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), color = list(L1 = "blue"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 1))*

*# From here, classical writting is use for single element in data1 and list writting otherwise*

*# color of dots. Example (3) when dots are in different categories. Note that categ argument controls the legend display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group")*

*# color of dots. Example (4) when dots are in different categories. A single color mentionned is applied to all the dots*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = "coral")*

*# color of dots. Example (5) when dots are in different categories. Numbers can be used if ggplot colors are desired*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = 2)*

*# color of dots. Example (6) when dots are in different categories, with one color per category (try also color = 2:1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = c("coral", "green"))*

*# color of dots. Example (7) when dots are in different categories, with colors as a data frame column. BEWARE: one color per category must be respected (try also numbers)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B"), col = rep(c("coral", "green"), each = 3)) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = obs1$col)*

*# color of dots. Example (8) when dots are in different categories, with colors as a data frame column. Easiest way (ggplot colors)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", color = as.numeric(obs1$group))*

*# legend name*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", legend.name = "CLASSES")*

*# different geom features. Example (1) with geom\_line kind of lines*

*# obs1 <- data.frame(km = c(1, 3, 2, 6, 4, 5), time = c(1, 3, 2, 6, 4, 5)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", geom = "geom\_line", categ = "group")*

*# different geom features. Example (2) with geom\_path kind of lines (see the difference with (1))*

*# obs1 <- data.frame(km = c(1, 3, 2, 6, 4, 5), time = c(1, 3, 2, 6, 4, 5)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", geom = "geom\_path", categ = "group")*

*# different geom features. Example (3) with geom\_hline kind of lines. Fake\_y y-axis name by default because y argument must be NULL (see ylab argument below to change this)*

*# obs1 <- data.frame(km = 1:2, time = (1:2)^2, group = c("A", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = NULL, y = "km", geom = "geom\_hline", categ = "group", xlim = c(1,10))*

*# different geom features. Example (4) with geom\_vline kind of lines. Fake\_y y-axis name by default because y argument must be NULL (see ylab argument below to change this)*

*# obs1 <- data.frame(km = 1:2, time = (1:2)^2, group = c("A", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = NULL, geom = "geom\_vline", categ = "group", ylim = c(1,10))*

*#### MULTI GEOMETRIC LAYERS*

*# Note that in subsequent examples, names of list compartments are systematically referred to as L1, L2, etc., to show the correspondence between the arguments data1, x, y, categ, etc.*

*# single layer (as examples above)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1), x = list(L1 = "km"), y = list(L1 = "time"), geom = list(L1 = "geom\_point"), alpha = list(L1 = 0.5))*

*# simple example of two layers*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# color of dots. Example (1)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (2) of the legend display. The categ argument must be supplied. Make a fake categorical colum in the data frame if necessary (as in this example). The categ argument triggers the legend display. The legend.name argument is used to remove the legend title of each layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = "GROUP1") ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = "GROUP2") ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = list(L1 = NULL, L2 = NULL), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (3) when dots are in different categories (default colors)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# color of dots. Example (3) when dots are in different categories. A single color mentionned per layer is applied to all the dots of the layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = "coral", L2 = "green"))*

*# color of dots. Example (5) when dots are in different categories, with one color per category in each layer*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = c("coral", "blue"), L2 = c("green", "black")))*

*# color of dots. Example (4) when dots are in different categories. Numbers can be used if ggplot colors are desired*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = 1:2, L2 = c(4, 7)))*

*# color of dots. Example (7) when dots are in different categories, with colors as a data frame column. BEWARE: one color per category must be respected (try also numbers). BEWARE: in color argument, if the column of the data frame does not exist, color can be still displayed (L2 = obs2$notgood is equivalent to L2 = NULL). Such situation is reported in the warning messages (see below)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500), col1 = rep(c("coral", "blue"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500), col2 = rep(c("green", "black"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = obs1$col1, L2 = obs2$col2))*

*# color of dots. Example (8) when dots are in different categories, with colors as a data frame column. Easiest way is not recommended with mutiple layers*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500), col1 = rep(c("coral", "blue"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500), col2 = rep(c("green", "black"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), color = list(L1 = as.numeric(obs1$group1), L2 = as.numeric(obs2$group2)))*

*# legend name*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), legend.name = list(L1 = "CLASS A", L2 = "CLASS G"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5))*

*# different geom features. Example (1) with 5 layers. Note that order in data1 defines the overlay order (from below to above) and the order in the legend (from top to bottom)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; obs3 <- data.frame(time = c(29, 31), group3 = c("HORIZ.THRESHOLD.1", "HORIZ.THRESHOLD.2")) ; obs4 <- data.frame(km = 26, group4 = "VERTIC.THRESHOLD") ; obs5 <- data.frame(km = seq(1, 100, 0.1), time = 7\*seq(1, 100, 0.1)^0.5, group5 = "FUNCTION") ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2, L3 = obs3, L4 = obs4, L5 = obs5), x = list(L1 = "km", L2 = "km", L3 = NULL, L4 = "km", L5 = "km"), y = list(L1 = "time", L2 = "time", L3 = "time", L4 = NULL, L5 = "time"), categ = list(L1 = "group1", L2 = "group2", L3 = "group3", L4 = "group4", L5 = "group5"), geom = list(L1 = "geom\_point", L2 = "geom\_point", L3 = "geom\_hline", L4 = "geom\_vline", L5 = "geom\_line"), alpha = list(L1 = 0.5, L2 = 0.5, L3 = 0.5, L4 = 0.5, L5 = 0.5), xlim = c(10, 40), ylim = c(10, 40), classic = TRUE, line.size = 0.75)*

*# layer transparency. One transparency defined by layer (from 0 invisible to 1 opaque). Note that for lines, transparency in not applied in the legend to prevent a ggplot2 bug (https://github.com/tidyverse/ggplot2/issues/2452)*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 22, 3), time = rnorm(1000, 22, 3), group1 = rep(c("A1", "A2"), each = 500)) ; obs2 <-data.frame(km = rnorm(1000, 30, 3), time = rnorm(1000, 30, 3), group2 = rep(c("G1", "G2"), each = 500)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), , categ = list(L1 = "group1", L2 = "group2"), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 1, L2 = 0.1))*

*# other different example of mutiple geom features are shown in the fun\_segmentation function*

*#### OTHER GRAPHIC ARGUMENTS*

*# dot size (line.size argument controls size of lines)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", dot.size = 5)*

*# axis management: examples are shown for x-axis but are identical for y-axis*

*# x-axis limits. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlim = c(-1, 25))*

*# x-axis limits. Example (2) showing that order matters in ylim argument*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlim = c(25, -1))*

*# log scale. Example (1). BEWARE: x column must be log, otherwise incoherent scale (see below warning message with the return argument)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10")*

*# log scale. Example (2). BEWARE: values of the xlim must be in the corresponding log*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", xlim = c(1, 10))*

*# tick number. Example (1). Note that the final number shown is approximate*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.tick.nb = 6)*

*# tick number. Example (2) using a log2 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log2", x.tick.nb = 6)*

*# tick number. Example (3) using a log10 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", x.tick.nb = 6)*

*# tick number. Example (4) using a log10 scale: the reverse x-axis correctly deal with log10 scale*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", xlim = c(7, 2))*

*# secondary tick number. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.inter.tick.nb = 4)*

*# secondary ticks. Example (2) not for log2 and log10 scales (see below warning message with the return argument)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", x.inter.tick.nb = 4)*

*# extra margins. To avoid dot cuts*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", x.left.extra.margin = 0.25, x.right.extra.margin = 0.25)*

*# include zero in both the x-axis and y-xis*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xy.include.zero = TRUE)*

*# graph title, text size and legend display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", categ = "group", text.size = 8, title = "GRAPH1", title.text.size = 16, show.legend = TRUE)*

*# raster display. This switchs from vectorial mode to raster mode. The display can takes some time, but this is easier to export and handle than vectorial display*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(100000, 22, 3), time = rnorm(100000, 22, 3)) ; set.seed(NULL) ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", raster = TRUE)*

*# classic representation (use grid = TRUE to display the background lines of the y axis ticks)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", classic = TRUE, grid = FALSE)*

*# graphic info. Example (1)*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", return = TRUE)*

*# graphic info. Example (2) of assignation and warning message display*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; output <- fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", xlog = "log10", return = TRUE) ; cat(output$warnings)*

*# add ggplot2 functions*

*# obs1 <- data.frame(km = 2:7, time = (2:7)^2, group = c("A", "A", "A", "B", "B", "B")) ; obs1 ; fun\_gg\_scatter(data1 = obs1, x = "km", y = "time", add = "+ggplot2::theme\_classic()")*

*# all the arguments*

*# set.seed(1) ; obs1 <- data.frame(km = rnorm(1000, 10, 3), time = rnorm(1000, 10, 3), group1 = rep(c("A1", "A2"), 500)) ; obs2 <-data.frame(km = rnorm(1000, 15, 3), time = rnorm(1000, 15, 3), group2 = rep(c("G1", "G2"), 500)) ; set.seed(NULL) ; obs1$L1$km[2:3] <- NA ; fun\_gg\_scatter(data1 = list(L1 = obs1, L2 = obs2), x = list(L1 = "km", L2 = "km"), y = list(L1 = "time", L2 = "time"), categ = list(L1 = "group1", L2 = "group2"), legend.name = NULL, color = list(L1 = 4:5, L2 = 7:8), geom = list(L1 = "geom\_point", L2 = "geom\_point"), alpha = list(L1 = 0.5, L2 = 0.5), dot.size = 3, line.size = 0.5, xlim = c(1, 25), xlab = "KM", xlog = "no", x.tick.nb = 10, x.inter.tick.nb = 1, x.left.extra.margin = 0, x.right.extra.margin = 0, ylim = c(1, 25), ylab = "TIME (s)", ylog = "log10", y.tick.nb = 5, y.inter.tick.nb = NULL, y.top.extra.margin = 0, y.bottom.extra.margin = 0, xy.include.zero = TRUE, text.size = 12, title = "", title.text.size = 8, show.legend = TRUE, classic = FALSE, grid = FALSE, raster = FALSE, vectorial.limit = NULL, return = FALSE, plot = TRUE, add = NULL, warn.print = TRUE, path.lib = NULL)*

*# DEBUGGING*

*# data1 = matrix(1:16, ncol = 4) ; legend.name1 = "" ; low.color1 = "blue" ; mid.color1 = "white" ; high.color1 = "red" ; limit1 = NULL ; midpoint1 = NULL ; data2 = matrix(rep(c(1,0,0,0), 4), ncol = 4) ; color2 = "black" ; alpha2 = 0.5 ; invert2 = FALSE ; text.size = 12 ; title = "" ; title.text.size = 12 ; show.scale = TRUE ; rotate = FALSE ; return = FALSE ; plot = TRUE ; add = NULL ; warn.print = TRUE ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_round", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_round() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# no reserved words required for this function*

*# argument checking*

**warning <- NULL**

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**if(all(is.matrix(data1))){**

**tempo <- fun\_check(data = data1, class = "matrix", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}else if(all(is.data.frame(data1))){**

**tempo <- fun\_check(data = data1, class = "data.frame", length = 3, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE){**

*# structure of reshape2::melt() data frame*

**tempo <- fun\_check(data = data1[, 1], typeof = "integer", fun.name = function.name)**

**tempo <- fun\_check(data = data1[, 2], typeof = "integer", fun.name = function.name)**

**tempo <- fun\_check(data = data1[, 3], mode = "numeric", na.contain = TRUE, fun.name = function.name)**

**}**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data1 ARGUMENT MUST BE A NUMERIC MATRIX OR A DATA FRAME OUTPUT OF THE reshape::melt() FUNCTION\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = legend.name1, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = low.color1, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (all(low.color1 %in% colors() | grepl(pattern = "^#", low.color1)))){** *# check that all strings of low.color1 start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": low.color1 ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(mid.color1)){**

**tempo <- fun\_check(data = mid.color1, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (all(mid.color1 %in% colors() | grepl(pattern = "^#", mid.color1)))){** *# check that all strings of mid.color1 start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": mid.color1 ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = high.color1, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (all(high.color1 %in% colors() | grepl(pattern = "^#", high.color1)))){** *# check that all strings of high.color1 start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": high.color1 ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(limit1)){**

**tempo <- fun\_check(data = limit1, class = "vector", mode = "numeric", length = 2, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & any(limit1 %in% c(Inf, -Inf))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": limit1 ARGUMENT CANNOT CONTAIN -Inf OR Inf VALUES\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(midpoint1)){**

**tempo <- fun\_check(data = midpoint1, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if( ! is.null(data2)){**

**if(all(is.matrix(data2))){**

**tempo <- fun\_check(data = data2, class = "matrix", mode = "numeric", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(unique(data2) %in% c(0,1))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": MATRIX IN data2 MUST BE MADE OF 0 AND 1 ONLY (MASK MATRIX)\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & all(is.matrix(data1)) & ! identical(dim(data1), dim(data2))){** *# matrix and matrix*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": MATRIX DIMENSION IN data2 MUST BE IDENTICAL AS MATRIX DIMENSION IN data1. HERE IT IS RESPECTIVELY:\n", paste(dim(data2), collapse = " "), "\n", paste(dim(data1), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & all(is.data.frame(data1)) & nrow(data1) != prod(dim(data2))){** *# reshape2 and matrix*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DATA FRAME IN data2 MUST HAVE ROW NUMBER EQUAL TO PRODUCT OF DIMENSIONS OF data1 MATRIX. HERE IT IS RESPECTIVELY:\n", paste(nrow(data1), collapse = " "), "\n", paste(prod(dim(data2)), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}else if(all(is.data.frame(data2))){**

**tempo <- fun\_check(data = data2, class = "data.frame", length = 3, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE){**

*# structure of reshape2::melt() data frame*

**tempo <- fun\_check(data = data2[, 1], typeof = "integer", fun.name = function.name)**

**tempo <- fun\_check(data = data2[, 2], typeof = "integer", fun.name = function.name)**

**tempo <- fun\_check(data = data2[, 3], mode = "numeric", fun.name = function.name)**

**}**

**if(tempo$problem == FALSE & ! all(unique(data2[, 3]) %in% c(0,1))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THIRD COLUMN OF DATA FRAME IN data2 MUST BE MADE OF 0 AND 1 ONLY (MASK DATA FRAME)\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & all(is.data.frame(data1)) & ! identical(dim(data1), dim(data2))){** *# data frame and data frame*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DATA FRAME DIMENSION IN data2 MUST BE IDENTICAL TO DATA FRAME DIMENSION IN data1. HERE IT IS RESPECTIVELY:\n", paste(dim(data2), collapse = " "), "\n", paste(dim(data1), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & all(is.matrix(data1)) & nrow(data2) != prod(dim(data1))){** *# reshape2 and matrix*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": DATA FRAME IN data2 MUST HAVE ROW NUMBER EQUAL TO PRODUCT OF DIMENSION OF data1 MATRIX. HERE IT IS RESPECTIVELY:\n", paste(nrow(data2), collapse = " "), "\n", paste(prod(dim(data1)), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}else{**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE data2 ARGUMENT MUST BE A NUMERIC MATRIX OR A DATA FRAME OUTPUT OF THE reshape::melt() FUNCTION\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = color2, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (all(color2 %in% colors() | grepl(pattern = "^#", color2)))){** *# check that all strings of color2 start by #*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": color2 ARGUMENT MUST BE A HEXADECIMAL COLOR VECTOR STARTING BY # AND/OR COLOR NAMES GIVEN BY colors()\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = alpha2, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = invert2, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = text.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = title.text.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = show.scale, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = return, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = plot, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(add)){**

**tempo <- fun\_check(data = add, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! grepl(pattern = "^\\+", add)){** *# check that the add string start by +*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST START WITH \"+\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = "ggplot2::", add)){** *#*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST CONTAIN \"ggplot2::\" IN FRONT OF EACH GGPLOT2 FUNCTION: ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & ! grepl(pattern = ")$", add)){** *# check that the add string finished by )*

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": add ARGUMENT MUST FINISH BY \")\": ", paste(unique(add), collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = c("reshape2", "ggplot2"), path.lib = path.lib)**

*# end package checking*

*# main code*

**if(all(is.matrix(data1))){**

**data1 <- reshape2::melt(data1)** *# transform a matrix into a dataframe with 2 coordinates columns and the third intensity column*

**}**

**if(rotate == TRUE){**

**data1[, 1] <- rev(data1[, 1])**

**}**

**if(is.null(limit1)){**

**if(any(data1[, 3] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data1 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE THIRD COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**limit1 <- range(data1[, 3], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE limit1 ARGUMENT IS NULL -> RANGE OF data1 ARGUMENT HAS BEEN TAKEN: ", paste(fun\_round(limit1), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**if(suppressWarnings(any(limit1 %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED LIMIT CONTAINS Inf VALUES, BECAUSE VALUES FROM data1 ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

**if(is.null(midpoint1)){**

**midpoint1 <- mean(limit1, na.rm = TRUE)**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE midpoint1 ARGUMENT IS NULL -> MEAN OF limit1 ARGUMENT HAS BEEN TAKEN: ", paste(fun\_round(midpoint1), collapse = " "))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else if(fun\_round(midpoint1, 9) != fun\_round(mean(limit1), 9)){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE midpoint1 ARGUMENT (", fun\_round(mean(midpoint1), 9), ") DOES NOT CORRESPOND TO THE MEAN OF THE limit1 ARGUMENT (", fun\_round(mean(limit1), 9), "). COLOR SCALE IS NOT LINEAR")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if( ! is.null(data2)){**

**if(all(is.matrix(data2))){**

**data2 <- reshape2::melt(data2)** *# transform a matrix into a dataframe with 2 coordinates columns and the third intensity column*

**}**

**if(rotate == TRUE){**

**data2[, 1] <- rev(data2[, 1])**

**}**

**data2[, 3] <- factor(data2[, 3])** *# to converte continuous scale into discrete scale*

**}**

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0** *# to facilitate debugging*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot())**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_raster(data = data1, mapping = ggplot2::aes\_string(x = names(data1)[ifelse(rotate == FALSE, 2, 1)], y = names(data1)[ifelse(rotate == FALSE, 1, 2)], fill = names(data1)[3]), show.legend = show.scale))** *# show.legend option do not remove the legend, only the aesthetic of the legend (dot, line, etc.)*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_fill\_gradient2(low = low.color1, high = high.color1, mid = mid.color1, midpoint = midpoint1, limit = limit1, breaks = c(limit1[1], midpoint1, limit1[2]), labels = fun\_round(c(limit1[1], midpoint1, limit1[2])), name = legend.name1))**

**if( ! is.null(data2)){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_raster(data = data2, mapping = ggplot2::aes\_string(x = names(data2)[ifelse(rotate == FALSE, 2, 1)], y = names(data2)[ifelse(rotate == FALSE, 1, 2)], alpha = names(data2)[3]), fill = color2, show.legend = FALSE))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_discrete\_manual(aesthetics = "alpha", values = if(invert2 == FALSE){c(0, alpha2)}else{c(alpha2, 0)}, guide = FALSE))**

*# assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_raster(data = data2, mapping = ggplot2::aes\_string(x = names(data2)[ifelse(rotate == FALSE, 2, 1)], y = names(data2)[ifelse(rotate == FALSE, 1, 2)], group = names(data2)[3]), fill = data2[, 3], alpha = alpha2, show.legend = FALSE)) # BEWARE: this does not work if NA present, because geom\_raster() has a tendency to complete empty spaces, and thus, behave differently than geom\_tile(). See https://github.com/tidyverse/ggplot2/issues/3025*

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::coord\_fixed())** *# x = y*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::scale\_y\_reverse())**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggtitle(title))**

**add.check <- TRUE**

**if( ! is.null(add)){** *# if add is NULL, then = 0*

**if(grepl(pattern = "ggplot2::theme", add) == TRUE){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": \"ggplot2::theme\" STRING DETECTED IN THE add ARGUMENT -> INTERNAL GGPLOT2 THEME FUNCTIONS theme() AND theme\_classic() HAVE BEEN INACTIVATED, TO BE USED BY THE USER")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**add.check <- FALSE**

**}**

**}**

**if(add.check == TRUE){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::theme\_classic(base\_size = text.size))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::theme(**

**text = ggplot2::element\_text(size = text.size),**

**plot.title = ggplot2::element\_text(size = title.text.size),** *# stronger than text*

**line = ggplot2::element\_blank(),**

**axis.title = ggplot2::element\_blank(),**

**axis.text = ggplot2::element\_blank(),**

**axis.ticks = ggplot2::element\_blank(),**

**panel.background = ggplot2::element\_blank(),**

**))**

**}**

**if(plot == TRUE){**

**# suppressWarnings(**

**print(eval(parse(text = paste(paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "), if(is.null(add)){NULL}else{add}))))**

**# )**

**}else{**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": PLOT NOT SHOWN AS REQUESTED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**if(return == TRUE){**

**output <- ggplot2::ggplot\_build(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + "))))**

**output <- output$data**

**names(output)[1] <- "heatmap"**

**if( ! is.null(data2)){**

**names(output)[2] <- "mask"**

**}**

**return(list(data = output, axes = output$layout$panel\_params[[1]], scale = c(limit1[1], midpoint1, limit1[2]), warnings = warning))**

**}**

**}**

######## fun\_gg\_empty\_graph() #### text to display for empty graphs



**# Check OK: clear to go Apollo**

**fun\_gg\_empty\_graph <- function(text = NULL, text.size = 12, title = NULL, title.size = 8, path.lib = NULL){**

*# AIM*

*# display an empty ggplot2 plot with a text in the middle of the window (for instance to specify that no plot can be drawn)*

*# ARGUMENTS*

*# text: character string of the message to display*

*# text.size: numeric value of the text size (in points)*

*# title: character string of the graph title*

*# title.size: numeric value of the title size (in points)*

*# path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# ggplot2*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# RETURN*

*# an empty plot*

*# EXAMPLES*

*# simple example*

*# fun\_gg\_empty\_graph(text = "NO GRAPH")*

*# white page*

*# fun\_gg\_empty\_graph()*

*# all the arguments*

*# fun\_gg\_empty\_graph(text = "NO GRAPH", text.size = 8, title = "GRAPH1", title.size = 10, path.lib = NULL)*

*# DEBUGGING*

*# text = "NO GRAPH" ; text.size = 12 ; title = "GRAPH1" ; title.size = 8 ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**if( ! is.null(text)){**

**tempo <- fun\_check(data = text, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = text.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(title)){**

**tempo <- fun\_check(data = title, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = title.size, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

*# end package checking*

*# main code*

**tempo.gg.name <- "gg.indiv.plot."**

**tempo.gg.count <- 0**

*# no need loop part*

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggplot())**

**if( ! is.null(text)){**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::geom\_text(data = data.frame(x = 1, y = 1), ggplot2::aes(x = x, y = y, label = text), size = text.size))**

**}**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::ggtitle(title))**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), ggplot2::theme\_void())**

**assign(paste0(tempo.gg.name, tempo.gg.count <- tempo.gg.count + 1), m.gg <- ggplot2::theme(**

**plot.title = ggplot2::element\_text(size = title.size)** *# stronger than text*

**))**

**suppressWarnings(print(eval(parse(text = paste(paste0(tempo.gg.name, 1:tempo.gg.count), collapse = " + ")))))**

**}**

################ Graphic extraction

######## fun\_trim() #### display values from a quantitative variable and trim according to defined cut-offs

**# Check OK: clear to go Apollo**

**fun\_trim <- function(data, displayed.nb = NULL, single.value.display = FALSE, trim.method = "", trim.cutoffs = c(0.05, 0.975), interval.scale.disp = TRUE, down.space = 0.75, left.space = 0.75, up.space = 0.3, right.space = 0.25, orient = 1, dist.legend = 0.37, box.type = "l", amplif.label = 1.25, amplif.axis = 1.25, std.x.range = TRUE, std.y.range = TRUE, cex.pt = 0.2, col.box = hsv(0.55, 0.8, 0.8), x.nb.inter.tick = 4, y.nb.inter.tick = 0, tick.length = 1, sec.tick.length = 0.75, corner.text = "", amplif.legend = 1, magnific.corner.text = 0.75, trim.return = FALSE){**

*# AIM*

*# trim and display values from a numeric vector or matrix*

*# plot 4 graphs: stripchart of values, stripchart of rank of values, hitogramme and normal QQPlot*

*# different kinds of intervals are displayed on the top of graphes to facilitate the analysis of the variable and a trimming setting*

*# the trimming interval chosen is displayed on top of graphs*

*# both trimmed and not trimmed values are returned in a list*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data: values to plot (either a numeric vector or a numeric matrix)*

*# displayed.nb: number of values displayed. If NULL, all the values are displayed. Otherwise, if the number of values is over displayed.nb, then displayed.nb values are displayed after random selection*

*# single.value.display: provide the 4 graphs if data is made of a single (potentially repeated value)? If FALSE, an empty graph is displayed if data is made of a single (potentially repeated value). And the return list is made of NULL compartments*

*# trim.method: Write "" if not required. write "mean.sd" if mean +/- sd has to be displayed as a trimming interval (only recommanded for normal distribution). Write "quantile" to display a trimming interval based on quantile cut-offs. No other possibility allowed. See trim.cutoffs below*

*# trim.cutoffs: 2 values cutoff for the trimming interval displayed, each value between 0 and 1. Not used if trim.method == "".The couple of values c(lower, upper) represents the lower and upper boundaries of the trimming interval (in proportion), which represent the interval of distribution kept (between 0 and 1). Example: trim.cutoffs = c(0.05, 0.975). What is strictly kept for the display is ]lower , upper[, boundaries excluded. Using the "mean.sd" method, 0.025 and 0.975 represent 95% CI which is mean +/- 1.96 \* sd*

*# interval.scale.disp: display sd and quantiles intervals on top of graphs ?*

*# down.space: lower vertical margin (in inches, mai argument of par())*

*# left.space: left horizontal margin (in inches, mai argument of par())*

*# up.space: upper vertical margin between plot region and grapical window (in inches, mai argument of par())*

*# right.space: right horizontal margin (in inches, mai argument of par())*

*# orient: scale number orientation (las argument of par()). 0, always parallel to the axis; 1, always horizontal; 2, always perpendicular to the axis; 3, always vertical*

*# dist.legend: numeric value that moves axis legends away in inches (first number of mgp argument of par() but in inches thus / 0.2)*

*# box.type: bty argument of par(). Either "o", "l", "7", "c", "u", "]", the resulting box resembles the corresponding upper case letter. A value of "n" suppresses the box*

*# amplif.label: increase or decrease the size of the text in legends*

*# amplif.axis: increase or decrease the size of the scale numbers in axis*

*# std.x.range: standard range on the x-axis? TRUE (no range extend) or FALSE (4% range extend). Controls xaxs argument of par() (TRUE is xaxs = "i", FALSE is xaxs = "r")*

*# std.y.range: standard range on the y-axis? TRUE (no range extend) or FALSE (4% range extend). Controls yaxs argument of par() (TRUE is yaxs = "i", FALSE is yaxs = "r")*

*# cex.pt: size of points in stripcharts (in inches, thus cex.pt will be thereafter / 0.2)*

*# col.box: color of boxplot*

*# x.nb.inter.tick: number of secondary ticks between main ticks on x-axis (only if not log scale). Zero means non secondary ticks*

*# y.nb.inter.tick: number of secondary ticks between main ticks on y-axis (only if not log scale). Zero means non secondary ticks*

*# tick.length: length of the ticks (1 means complete the distance between the plot region and the axis numbers, 0.5 means half the length, etc. 0 means no tick*

*# sec.tick.length: length of the secondary ticks (1 means complete the distance between the plot region and the axis numbers, 0.5 means half the length, etc., 0 for no ticks)*

*# corner.text: text to add at the top right corner of the window*

*# amplif.legend: increase or decrease the size of the text of legend*

*# magnific.corner.text: increase or decrease the size of the text*

*# trim.return: return the trimmed and non trimmed values? NULL returned for trimmed and non trimmed values if trim.method == ""*

*# RETURN*

*# a list containing:*

*# $trim.method: correspond to trim.method above*

*# $trim.cutoffs: correspond to trim.cutoffs above*

*# $real.trim.cutoffs: the two boundary values (in the unit of the numeric vector or numeric matrix analyzed). NULL*

*# $trimmed.values: the values outside of the trimming interval as defined in trim.cutoffs above*

*# $kept.values: the values inside the trimming interval as defined in trim.cutoffs above*

*# EXAMPLES*

*# fun\_trim(data = c(1:100, 1:10), displayed.nb = NULL, single.value.display = FALSE, trim.method = "mean.sd", trim.cutoffs = c(0.05, 0.975), interval.scale.disp = TRUE, down.space = 0.75, left.space = 0.75, up.space = 0.3, right.space = 0.25, orient = 1, dist.legend = 0.37, box.type = "l", amplif.label = 1.25, amplif.axis = 1.25, std.x.range = TRUE, std.y.range = TRUE, cex.pt = 0.2, col.box = hsv(0.55, 0.8, 0.8), x.nb.inter.tick = 4, y.nb.inter.tick = 0, tick.length = 0.5, sec.tick.length = 0.3, corner.text = "", amplif.legend = 1, magnific.corner.text = 0.75, trim.return = TRUE)*

*# DEBUGGING*

*# data = c(1:100, 1:10) ; displayed.nb = NULL ; single.value.display = FALSE ; trim.method = "quantile" ; trim.cutoffs = c(0.05, 0.975) ; interval.scale.disp = TRUE ; down.space = 1 ; left.space = 1 ; up.space = 0.5 ; right.space = 0.25 ; orient = 1 ; dist.legend = 0.5 ; box.type = "l" ; amplif.label = 1 ; amplif.axis = 1 ; std.x.range = TRUE ; std.y.range = TRUE ; cex.pt = 0.1 ; col.box = hsv(0.55, 0.8, 0.8) ; x.nb.inter.tick = 4 ; y.nb.inter.tick = 0 ; tick.length = 0.5 ; sec.tick.length = 0.3 ; corner.text = "" ; amplif.legend = 1 ; magnific.corner.text = 0.75 ; trim.return = TRUE # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if( ! (all(class(data) == "numeric") | all(class(data) == "integer") | (all(class(data) == "matrix") & mode(data) == "numeric"))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data ARGUMENT MUST BE A NUMERIC VECTOR OR NUMERIC MATRIX\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**if( ! is.null(displayed.nb)){**

**tempo <- fun\_check(data = displayed.nb, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(displayed.nb < 2){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": displayed.nb ARGUMENT MUST BE A SINGLE INTEGER VALUE GREATER THAN 1 AND NOT: ", paste(displayed.nb, collapse = " "), "\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = single.value.display, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = trim.method, options = c("", "mean.sd", "quantile"), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = trim.cutoffs, class = "vector", mode = "numeric", length = 2, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = interval.scale.disp, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = down.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = left.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = up.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = right.space, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = orient, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = dist.legend, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = box.type, options = c("o", "l", "7", "c", "u", "]", "n"), length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = amplif.label, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = amplif.axis, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = std.x.range, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = std.y.range, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = cex.pt, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = col.box, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = x.nb.inter.tick, class = "integer", length = 1, neg.values = FALSE, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = y.nb.inter.tick, class = "integer", length = 1, neg.values = FALSE, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = tick.length, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = sec.tick.length, class = "vector", mode = "numeric", length = 1, prop = TRUE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = corner.text, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = amplif.legend, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = magnific.corner.text, class = "vector", mode = "numeric", length = 1, neg.values = FALSE, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = trim.return, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**if(class(data) == "matrix"){**

**data <- as.vector(data)**

**}**

**color.cut <- hsv(0.75, 1, 1)** *# color of interval selected*

**col.mean <- hsv(0.25, 1, 0.8)** *# color of interval using mean+/-sd*

**col.quantile <- "orange"** *# color of interval using quantiles*

**quantiles.selection <- c(0.01, 0.025, 0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95, 0.975, 0.99)** *# quantiles used in axis to help for choosing trimming cutoffs*

**if(single.value.display == FALSE & length(unique(data)) == 1){**

**par(bty = "n", xaxt = "n", yaxt = "n", xpd = TRUE)**

**plot(1, pch = 16, col = "white", xlab = "", ylab = "")**

**text(x = 1, y = 1, paste0("No graphic displayed\nBecause data made of a single different value (", formatC(as.double(table(data))), ")"), cex = 2)**

**output <- list(trim.method = NULL, trim.cutoffs = NULL, real.trim.cutoffs = NULL, trimmed.values = NULL, kept.values = NULL)**

**}else{**

**output <- list(trim.method = trim.method, trim.cutoffs = trim.cutoffs, real.trim.cutoffs = NULL, trimmed.values = NULL, kept.values = NULL)**

**fun.rug <- function(sec.tick.length.f = sec.tick.length, x.nb.inter.tick.f = x.nb.inter.tick, y.nb.inter.tick.f = y.nb.inter.tick){**

**if(x.nb.inter.tick.f > 0){**

**inter.tick.unit <- (par("xaxp")[2] - par("xaxp")[1]) / par("xaxp")[3]**

**par.ini <- par()[c("xpd", "tcl")]**

**par(xpd = FALSE)**

**par(tcl = -par()$mgp[2] \* sec.tick.length.f)** *# tcl gives the length of the ticks as proportion of line text, knowing that mgp is in text lines. So the main ticks are a 0.5 of the distance of the axis numbers by default. The sign provides the side of the tick (negative for outside of the plot region)*

**suppressWarnings(rug(seq(par("xaxp")[1] - 10 \* inter.tick.unit, par("xaxp")[2] + 10 \* inter.tick.unit, by = inter.tick.unit / (1 + x.nb.inter.tick.f)), ticksize = NA, side = 1))** *# ticksize = NA to allow the use of par()$tcl value*

**par(par.ini)**

**rm(par.ini)**

**}**

**if(y.nb.inter.tick.f > 0){**

**inter.tick.unit <- (par("yaxp")[2] - par("yaxp")[1]) / par("yaxp")[3]**

**par.ini <- par()[c("xpd", "tcl")]**

**par(xpd = FALSE)**

**par(tcl = -par()$mgp[2] \* sec.tick.length.f)** *# tcl gives the length of the ticks as proportion of line text, knowing that mgp is in text lines. So the main ticks are a 0.5 of the distance of the axis numbers by default. The sign provides the side of the tick (negative for outside of the plot region)*

**suppressWarnings(rug(seq(par("yaxp")[1] - 10 \* inter.tick.unit, par("yaxp")[2] + 10 \* inter.tick.unit, by = inter.tick.unit / (1 + y.nb.inter.tick.f)), ticksize = NA, side = 2))** *# ticksize = NA to allow the use of par()$tcl value*

**par(par.ini)**

**rm(par.ini)**

**}**

**}**

**fun.add.cut <- function(data.f, trim.method.f = trim.method, trim.cutoffs.f = trim.cutoffs, color.cut.f = color.cut, return.f = FALSE){**

*# DEBUGGING*

*# data.f = data ; trim.method.f = "mean.sd"; trim.cutoffs.f = trim.cutoffs ; color.cut.f = color.cut ; return.f = TRUE*

**real.trim.cutoffs.f <- NULL**

**if(trim.method.f != ""){**

**data.f <- sort(data.f)**

**par.ini <- par()$xpd**

**par(xpd = FALSE)**

**if(trim.method.f == "mean.sd"){**

**real.trim.cutoffs.f <- qnorm(trim.cutoffs.f, mean(data.f, na.rm = TRUE), sd(data.f, na.rm = TRUE))**

**abline(v = qnorm(trim.cutoffs.f, mean(data.f, na.rm = TRUE), sd(data.f, na.rm = TRUE)), col = color.cut.f)**

**segments(qnorm(trim.cutoffs.f[1], mean(data.f, na.rm = TRUE), sd(data.f, na.rm = TRUE)), par()$usr[4] \* 0.75, qnorm(trim.cutoffs.f[2], mean(data.f, na.rm = TRUE), sd(data.f, na.rm = TRUE)), par()$usr[4] \* 0.75, col = color.cut.f)**

**}**

**if(trim.method.f == "quantile"){**

**real.trim.cutoffs.f <- quantile(data.f, probs = trim.cutoffs.f, type = 7)**

**abline(v = quantile(data.f, probs = trim.cutoffs.f, type = 7), col = color.cut.f)**

**segments(quantile(data.f, probs = trim.cutoffs.f[1], type = 7), par()$usr[4] \* 0.75, quantile(data.f, probs = trim.cutoffs.f[2], type = 7), par()$usr[4] \* 0.75, col = color.cut.f)**

**}**

**par(par.ini)**

**if(return.f == TRUE){**

**trimmed.values.f <- data.f[data.f <= real.trim.cutoffs.f[1] | data.f >= real.trim.cutoffs.f[2]]**

**kept.values.f <- data.f[data.f > real.trim.cutoffs.f[1] & data.f < real.trim.cutoffs.f[2]]**

**}**

**}else{**

**real.trim.cutoffs.f <- NULL**

**trimmed.values.f <- NULL**

**kept.values.f <- NULL**

**}**

**if(return.f == TRUE){**

**output <- list(trim.method = trim.method.f, trim.cutoffs = trim.cutoffs.f, real.trim.cutoffs = real.trim.cutoffs.f, trimmed.values = trimmed.values.f, kept.values = kept.values.f)**

**return(output)**

**}**

**}**

**fun.interval.scale.display <- function(data.f, col.quantile.f = col.quantile, quantiles.selection.f = quantiles.selection, col.mean.f = col.mean){** *# intervals on top of graphs*

**par.ini <- par()[c("mgp", "xpd")]**

**par(mgp = c(0.25, 0.25, 0), xpd = NA)**

**axis(side = 3, at = c(par()$usr[1], par()$usr[2]), labels = rep("", 2), col = col.quantile.f, lwd.ticks = 0)**

**par(xpd = FALSE)**

**axis(side = 3, at = quantile(as.vector(data.f), probs = quantiles.selection.f, type = 7), labels = quantiles.selection.f, col.axis = col.quantile.f, col = col.quantile.f)**

**par(mgp = c(1.75, 1.75, 1.5), xpd = NA)**

**axis(side = 3, at = c(par()$usr[1], par()$usr[2]), labels = rep("", 2), col = col.mean.f, lwd.ticks = 0)**

**par(xpd = FALSE)**

**axis(side = 3, at = m + s \* qnorm(quantiles.selection.f), labels = formatC(round(qnorm(quantiles.selection.f), 2)), col.axis = col.mean.f, col = col.mean.f, lwd.ticks = 1)**

**par(par.ini)**

**}**

**zone<-matrix(1:4, ncol=2)**

**layout(zone)**

**par(omi = c(0, 0, 1.5, 0), mai = c(down.space, left.space, up.space, right.space), las = orient, mgp = c(dist.legend / 0.2, 0.5, 0), xpd = FALSE, bty= box.type, cex.lab = amplif.label, cex.axis = amplif.axis, xaxs = ifelse(std.x.range, "i", "r"), yaxs = ifelse(std.y.range, "i", "r"))**

**par(tcl = -par()$mgp[2] \* tick.length)** *# tcl gives the length of the ticks as proportion of line text, knowing that mgp is in text lines. So the main ticks are a 0.5 of the distance of the axis numbers by default. The sign provides the side of the tick (negative for outside of the plot region)*

**if(is.null(displayed.nb)){**

**sampled.data <- as.vector(data)**

**if(corner.text == ""){**

**corner.text <- paste0("ALL VALUES OF THE DATASET DISPLAYED")**

**}else{**

**corner.text <- paste0(corner.text, "\nALL VALUES OF THE DATASET DISPLAYED")**

**}**

**}else{**

**if(length(as.vector(data)) > displayed.nb){**

**sampled.data <- sample(as.vector(data), displayed.nb, replace = FALSE)**

**if(corner.text == ""){**

**corner.text <- paste0("BEWARE: ONLY ", displayed.nb, " VALUES ARE DISPLAYED AMONG THE ", length(as.vector(data)), " VALUES OF THE DATASET ANALYZED")**

**}else{**

**corner.text <- paste0(corner.text, "\nBEWARE: ONLY ", displayed.nb, " VALUES ARE DISPLAYED AMONG THE ", length(as.vector(data)), " VALUES OF THE DATASET ANALYZED")**

**}**

**}else{**

**sampled.data <- as.vector(data)**

**if(corner.text == ""){**

**corner.text <- paste0("BEWARE: THE DISPLAYED NUMBER OF VALUES PARAMETER ", deparse(substitute(displayed.nb)), " HAS BEEN SET TO ", displayed.nb, " WHICH IS ABOVE THE NUMBER OF VALUES OF THE DATASET ANALYZED -> ALL VALUES DISPLAYED")**

**}else{**

**corner.text <- paste0(corner.text, "\nBEWARE: THE DISPLAYED NUMBER OF VALUES PARAMETER ", deparse(substitute(displayed.nb)), " HAS BEEN SET TO ", displayed.nb, " WHICH IS ABOVE THE NUMBER OF VALUES OF THE DATASET ANALYZED -> ALL VALUES DISPLAYED")**

**}**

**}**

**}**

**stripchart(sampled.data, method="jitter", jitter=0.4, vertical=FALSE, ylim=c(0.5, 1.5), group.names = "", xlab = "Value", ylab="", pch=1, cex = cex.pt / 0.2)**

**fun.rug(y.nb.inter.tick.f = 0)**

**boxplot(as.vector(data), horizontal=TRUE, add=TRUE, boxwex = 0.4, staplecol = col.box, whiskcol = col.box, medcol = col.box, boxcol = col.box, range = 0, whisklty = 1)**

**m <- mean(as.vector(data), na.rm = TRUE)**

**s <- sd(as.vector(data), na.rm = TRUE)**

**segments(m, 0.8, m, 1, lwd=2, col="red")** *# mean*

**segments(m -1.96 \* s, 0.9, m + 1.96 \* s, 0.9, lwd=1, col="red")** *# mean*

**graph.xlim <- par()$usr[1:2]** *# for hist() and qqnorm() below*

**if(interval.scale.disp == TRUE){**

**fun.interval.scale.display(data.f = data)**

**if(corner.text == ""){**

**corner.text <- paste0("MULTIPLYING FACTOR DISPLAYED (MEAN +/- SD) ON SCALES: ", paste(formatC(round(qnorm(quantiles.selection), 2))[-(1:(length(quantiles.selection) - 1) / 2)], collapse = ", "), "\nQUANTILES DISPLAYED ON SCALES: ", paste(quantiles.selection, collapse = ", "))**

**}else{**

**corner.text <- paste0(corner.text, "\nMULTIPLYING FACTOR DISPLAYED (MEAN +/- SD) ON SCALES: ", paste(formatC(round(qnorm(quantiles.selection), 2))[-(1:(length(quantiles.selection) - 1) / 2)], collapse = ", "), "\nQUANTILES DISPLAYED ON SCALES: ", paste(quantiles.selection, collapse = ", "))**

**}**

**}**

**output.tempo <- fun.add.cut(data.f = data, return.f = TRUE)** *# to recover real.trim.cutoffs*

**if(trim.return == TRUE){**

**output <- output.tempo**

**}**

**par(xpd = NA)**

**if(trim.method != ""){**

**if(corner.text == ""){**

**corner.text <- paste0("SELECTED CUT-OFFS (PROPORTION): ", paste(trim.cutoffs, collapse = ", "), "\nSELECTED CUT-OFFS: ", paste(output.tempo$real.trim.cutoffs, collapse = ", "))**

**}else{**

**corner.text <- paste0(corner.text, "\nSELECTED CUT-OFFS (PROPORTION): ", paste(trim.cutoffs, collapse = ", "), "\nSELECTED CUT-OFFS: ", paste(output.tempo$real.trim.cutoffs, collapse = ", "))**

**}**

**if(interval.scale.disp == TRUE){**

**legend(x = (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / (par("omd")[2] - par("omd")[1])) \* par("omd")[1]), y = (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / (par("omd")[4] - par("omd")[3])) \* (1 - par("omd")[4]) / 2), legend = c(c("min, Q1, Median, Q3, max"), "mean +/- 1.96sd", paste0("Trimming interval: ", paste0(trim.cutoffs, collapse = " , ")), "Mean +/- sd multiplying factor", "Quantile"), yjust = 0, lty=1, col=c(col.box, "red", color.cut, col.mean, col.quantile), bty="n", cex = amplif.legend)**

**}else{**

**legend(x = (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / (par("omd")[2] - par("omd")[1])) \* par("omd")[1]), y = (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / (par("omd")[4] - par("omd")[3])) \* (1 - par("omd")[4]) / 2), legend = c(c("min, Q1, Median, Q3, max"), "mean +/- 1.96sd", paste0("Trimming interval: ", paste0(trim.cutoffs, collapse = " , "))), yjust = 0, lty=1, col=c(col.box, "red", color.cut), bty="n", cex = amplif.legend, y.intersp=1.25)**

**}**

**}else{**

**if(interval.scale.disp == TRUE){**

**legend(x = (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / (par("omd")[2] - par("omd")[1])) \* par("omd")[1]), y = (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / (par("omd")[4] - par("omd")[3])) \* (1 - par("omd")[4]) / 2), legend = c(c("min, Q1, Median, Q3, max"), "mean +/- sd", "Mean +/- sd multiplying factor", "Quantile"), yjust = 0, lty=1, col=c(col.box, "red", col.mean, col.quantile), bty="n", cex = amplif.legend)**

**}else{**

**legend(x = (par("usr")[1] - ((par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1])) \* par("plt")[1] - ((par("usr")[2] - par("usr")[1]) / (par("omd")[2] - par("omd")[1])) \* par("omd")[1]), y = (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / (par("omd")[4] - par("omd")[3])) \* (1 - par("omd")[4]) / 2), legend = c(c("min, Q1, Median, Q3, max"), "mean +/- sd"), yjust = 0, lty=1, col=c(col.box, "red"), bty="n", cex = amplif.legend, y.intersp=1.25)**

**}**

**}**

**par(xpd = FALSE, xaxs = ifelse(std.x.range, "i", "r"), yaxs = ifelse(std.y.range, "i", "r"))**

**hist(as.vector(data), main = "", breaks = seq(min(as.vector(data), na.rm = TRUE), max(as.vector(data), na.rm = TRUE), length.out = length(as.vector(data)) / 10), xlim = graph.xlim, xlab = "Value", ylab="Density", col = grey(0.25))**

**abline(h = par()$usr[3])**

**fun.rug()**

**if(interval.scale.disp == TRUE){**

**fun.interval.scale.display(data.f = data)**

**}**

**fun.add.cut(data.f = data)**

**par(xaxs = ifelse(std.x.range, "i", "r"))**

**stripchart(rank(sampled.data), method="stack", vertical=FALSE, ylim=c(0.99, 1.3), group.names = "", xlab = "Rank of values", ylab="", pch=1, cex = cex.pt / 0.2)**

**fun.rug(y.nb.inter.tick.f = 0)**

**x.text <- par("usr")[2] + (par("usr")[2] - par("usr")[1]) / (par("plt")[2] - par("plt")[1]) \* (1 - par("plt")[2]) / 2**

**y.text <- (par("usr")[4] + ((par("usr")[4] - par("usr")[3]) / (par("plt")[4] - par("plt")[3])) \* (1 - par("plt")[4]) + ((par("usr")[4] - par("usr")[3]) / ((par()$omd[4] / 2) \* ((par("plt")[4] - par("plt")[3])))) \* (1 - par("omd")[4]))** *# BEWARE. Here in "(par()$omd[4] / 2", division by two because there are 2 graphs staked on the y axis, and not one*

**par(xpd=NA)**

**text(x = x.text, y = y.text, paste0(corner.text), adj=c(1, 1.1), cex = magnific.corner.text)** *# text at the topright corner*

**par(xpd=FALSE)**

**par(xaxs = ifelse(std.x.range, "i", "r"), yaxs = ifelse(std.y.range, "i", "r"))**

**qqnorm(as.vector(sampled.data), main = "", datax = TRUE, ylab = "Value", pch = 1, col = "red", cex = cex.pt / 0.2)**

**fun.rug()**

**if(diff(quantile(as.vector(data), probs = c(0.25, 0.75), na.rm = TRUE)) != 0){** *# otherwise, error generated*

**qqline(as.vector(data), datax = TRUE)**

**}**

**if(interval.scale.disp == TRUE){**

**fun.interval.scale.display(data.f = data)**

**}**

**fun.add.cut(data.f = data)**

**}**

**if(trim.return == TRUE){**

**return(output)**

**}**

**}**

######## fun\_segmentation() #### segment a dot cloud on a scatterplot and define the dots from another cloud outside the segmentation

**# Check OK: clear to go Apollo**

**fun\_segmentation <- function(data1, x1, y1, x.range.split = NULL, x.step.factor = 10, y.range.split = NULL, y.step.factor = 10, error = 0, data2 = NULL, x2, y2, data2.pb.dot = "unknown", xy.cross.kind = "&", plot = FALSE, graph.in.file = FALSE, raster = TRUE, warn.print = FALSE, path.lib = NULL){**

*# AIM*

*# if data1 is a data frame corresponding to the data set of a scatterplot (with a x column for x-axis values and a y column for the y-axis column), then fun\_segmentation() delimits a frame around the dots cloud using a sliding window set by x.range.split and x.step.factor to frame the top and bottom part of the cloud, and set by y.range.split and y.step.factor to frame the left and right part of the cloud*

*# if a second data frame is provided, corresponding to the data set of a scatterplot (with a x column for x-axis values and a y column for the y-axis column), then fun\_segmentation() defines the dots of this data frame, outside of the frame of the first data frame*

*# WARNINGS*

*# if dots from data2 look significant on the graph (outside the frame) but are not (not black on the last figure), this is probably because the frame is flat on the zero coordinate (no volume inside the frame at this position). Thus, no way to conclude that data2 dots here are significant. These dots are refered to as "unknown". The pb.dot argument deals with such dots*

*# dots that are sometimes inside and outside the frame, depending on the sliding windows, are treated differently: they are removed. Such dots are neither classified as "signif", "non signif" or "unknown", but as "inconsistent"*

*# unknown dots are treated as finally significant, not significant, or unknown (data2.pb.dot argument) for each x-axis and y-axis separately. Then, the union or intersection of significant dots is performed (argument xy.cross.kind). See the example section*

*# ARGUMENTS*

*# data1: a dataframe containing a column of x-axis values and a column of y-axis values*

*# x1: character string of the data1 column name for x-axis (first column of data1 by default)*

*# y1: character string of the data1 column name for y-axis (second column of data1 by default)*

*# x.range.split: positive non null numeric value giving the number of interval on the x value range. if x.range is the range of the dots on the x-axis, then abs(diff(x.range) / x.range.split) gives the window size. Window size decreases when range.split increases. In unit of x-axis. Write NULL if not required. At least one of the x.range.split and y.range.split must be non NULL*

*# x.step.factor: positive non null numeric value giving the shift step of the window. If x.step.factor = 1, no overlap during the sliding (when the window slides from position n to position n+1, no overlap between the two positions). If x.step.factor = 2, 50% of overlap (when the window slides from position n to position n+1, the window on position n+1 overlap 50% of the window when it was on position n)*

*# y.range.split: same as x.range.split for the y-axis. At least one of the x.range.split and y.range.split must be non NULL*

*# y.step.factor: same as x.step.factor for the y-axis*

*# error: proportion (from 0 to 1) of false positives (i.e., proportion of dots from data1 outside of the frame). 0.05 means 5% of the dots from data1 outside of the frame*

*# data2: a dataframe containing a column of x-axis values and a column of y-axis values, for which outside dots of the data1 cloud has to be determined. Write NULL if not required*

*# x2: character string of the data1 column name for x-axis (first column of data1 by default)*

*# y2: character string of the data1 column name for y-axis (second column of data1 by default)*

*# data2.pb.dot: unknown dots are explain in the warning section above. If "signif", then the unknown dots are finally considered as significant (outside the frame). If "not.signif", then the unknown dots are finally considered as non significant (inside the frame). If "unknown", no conclusion are drawn from these dots. See the examples below*

*# xy.cross.kind: if data2 is non null and if both x.range.split and y.range.split are non null, which dots are finally significants? Write "&" for intersection of outside dots on x and on y. Write "|" for union of outside dots on x and on y. See the examples below*

*# plot: logical. Print graphs that check the frame?*

*# graph.in.file: logical. Graphs sent into a graphic device already opened? If FALSE, GUI are opened for each graph. If TRUE, no GUI are opended. The graphs are displayed on the current active graphic device. Ignored if plot is FALSE*

*# raster: logical. Dots in raster mode? If FALSE, dots from each geom\_point from geom argument are in vectorial mode (bigger pdf and long to display if millions of dots). If TRUE, dots from each geom\_point from geom argument are in matricial mode (smaller pdf and easy display if millions of dots, but long to generate the layer). If TRUE, the region plot will be square to avoid a bug in fun\_gg\_point\_rast(). If TRUE, solve the transparency problem with some GUI. Not considered if plot is FALSE*

*# warn.print: logical. Print warnings at the end of the execution? No print if no warning messages*

*# path.lib: absolute path of the required packages, if not in the default folders. Ignored if plot is FALSE*

*# REQUIRED PACKAGES*

*# ggplot2 if plot is TRUE*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# if plot is TRUE:*

*# fun\_pack()*

*# fun\_open()*

*# fun\_gg\_palette()*

*# fun\_gg\_scatter()*

*# fun\_gg\_empty\_graph()*

*# fun\_close()*

*# RETURN*

*# several graphs if plot is TRUE*

*# a list containing:*

*# $data1.removed.row.nb: which rows have been removed due to NA; NaN, -Inf or Inf detection in x1 or y1 columns (NULL if no row removed)*

*# $data1.removed.rows: removed rows (NULL if no row removed)*

*# $data2.removed.row.nb: which rows have been removed due to NA; NaN, -Inf or Inf detection in x2 or y2 columns (NULL if no row removed)*

*# $data2.removed.rows: removed rows (NULL if no row removed)*

*# $hframe: x and y coordinates of the bottom and top frames for frame plotting (frame1 for the left step and frame2 for the right step)*

*# $vframe: x and y coordinates of the left and right frames for frame plotting (frame1 for the down step and frame2 for the top step)*

*# $data1.signif.dot: the significant dots of data1 (i.e., dots outside the frame). A good segmentation should not have any data1.signif.dot*

*# $data1.non.signif.dot: the non significant dots of data1 (i.e., dots inside the frame)*

*# $data1.inconsistent.dot: see the warning section above*

*# $data2.signif.dot: the significant dots of data2 if non NULL (i.e., dots outside the frame)*

*# $data2.non.signif.dot: the non significant dots of data2 (i.e., dots inside the frame)*

*# $data2.unknown.dot: the problematic dots of data2 (i.e., data2 dots outside of the range of data1, or data2 dots in a sliding window without data1 dots). Is systematically NULL except if argument data2.pb.dot = "unknown" and some data2 dots are in such situation. Modifying the segmentation x.range.split, x.step.factor, y.range.split, y.step.factor arguments can solve this problem*

*# $data2.inconsistent.dot: see the warning section above*

*# $axes: the x-axis and y-axis info*

*# $warnings: the warning messages. Use cat() for proper display. NULL if no warning*

*# EXAMPLES*

*# example explaining the unknown and inconsistent dots, and the cross*

*# set.seed(1) ; data1 = data.frame(x = rnorm(500), y = rnorm(500)) ; data1[5:7, 2] <- NA ; data2 = data.frame(x = rnorm(500, 0, 2), y = rnorm(500, 0, 2)) ; data2[11:13, 1] <- Inf ; set.seed(NULL) ; fun\_segmentation(data1 = data1, x1 = names(data1)[1], y1 = names(data1)[2], x.range.split = 20, x.step.factor = 10, y.range.split = 23, y.step.factor = 10, error = 0, data2 = data2, x2 = names(data2)[1], y2 = names(data2)[2], data2.pb.dot = "not.signif", xy.cross.kind = "|", plot = TRUE, graph.in.file = FALSE, raster = FALSE, path.lib = NULL)*

*# set.seed(1) ; data1 = data.frame(x = rnorm(500), y = rnorm(500)) ; data2 = data.frame(x = rnorm(500, 0, 2), y = rnorm(500, 0, 2)) ; set.seed(NULL) ; fun\_segmentation(data1 = data1, x1 = names(data1)[1], y1 = names(data1)[2], x.range.split = NULL, x.step.factor = 10, y.range.split = 23, y.step.factor = 10, error = 0, data2 = data2, x2 = names(data2)[1], y2 = names(data2)[2], data2.pb.dot = "unknown", xy.cross.kind = "|", plot = TRUE, graph.in.file = FALSE, raster = FALSE, path.lib = NULL)*

*# set.seed(1) ; data1 = data.frame(x = rnorm(500), y = rnorm(500)) ; data2 = data.frame(x = rnorm(500, 0, 2), y = rnorm(500, 0, 2)) ; set.seed(NULL) ; fun\_segmentation(data1 = data1, x1 = names(data1)[1], y1 = names(data1)[2], x.range.split = 20, x.step.factor = 10, y.range.split = NULL, y.step.factor = 10, error = 0, data2 = data2, x2 = names(data2)[1], y2 = names(data2)[2], data2.pb.dot = "unknown", xy.cross.kind = "&", plot = TRUE, graph.in.file = FALSE, raster = FALSE, path.lib = NULL)*

*# DEBUGGING*

*# set.seed(1) ; data1 = data.frame(x = rnorm(50), y = rnorm(50)) ; data1[5:7, 2] <- NA ; x1 = names(data1)[1] ; y1 = names(data1)[2] ; x.range.split = 5 ; x.step.factor = 10 ; y.range.split = 5 ; y.step.factor = 10 ; error = 0 ; data2 = data.frame(x = rnorm(50, 0, 2), y = rnorm(50, 0, 2)) ; set.seed(NULL) ; x2 = names(data2)[1] ; y2 = names(data2)[2] ; data2.pb.dot = "unknown" ; xy.cross.kind = "|" ; plot = TRUE ; graph.in.file = FALSE ; raster = FALSE ; warn.print = TRUE ; path.lib = NULL*

*# set.seed(1) ; data1 = data.frame(x = rnorm(500), y = rnorm(500)) ; data2 = data.frame(x = rnorm(500, 0, 2), y = rnorm(500, 0, 2)) ; set.seed(NULL) ; x1 = names(data1)[1] ; y1 = names(data1)[2] ; x.range.split = NULL ; x.step.factor = 10 ; y.range.split = 23 ; y.step.factor = 10 ; error = 0 ; x2 = names(data2)[1] ; y2 = names(data2)[2] ; data2.pb.dot = "unknown" ; xy.cross.kind = "|" ; plot = TRUE ; graph.in.file = FALSE ; raster = FALSE ; warn.print = TRUE ; path.lib = NULL*

*# set.seed(1) ; data1 = data.frame(x = rnorm(500), y = rnorm(500)) ; data2 = data.frame(x = rnorm(500, 0, 2), y = rnorm(500, 0, 2)) ; set.seed(NULL) ; x1 = names(data1)[1] ; y1 = names(data1)[2] ; x.range.split = 20 ; x.step.factor = 10 ; y.range.split = NULL ; y.step.factor = 10 ; error = 0 ; x2 = names(data2)[1] ; y2 = names(data2)[2] ; data2.pb.dot = "unknown" ; xy.cross.kind = "&" ; plot = TRUE ; graph.in.file = FALSE ; raster = FALSE ; warn.print = TRUE ; path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**warning <- NULL**

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = data1, class = "data.frame", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & length(data1) < 2){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": data1 ARGUMENT MUST BE A DATA FRAME OF AT LEAST 2 COLUMNS\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = x1, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (x1 %in% names(data1))){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": x1 ARGUMENT MUST BE A COLUMN NAME OF data1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & x1 %in% names(data1)){**

**tempo <- fun\_check(data = data1[, x1], data.name = "x1 COLUMN OF data1", class = "vector", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = y1, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (y1 %in% names(data1))){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": y1 ARGUMENT MUST BE A COLUMN NAME OF data1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & y1 %in% names(data1)){**

**tempo <- fun\_check(data = data1[, y1], data.name = "y1 COLUMN OF data1", class = "vector", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**if(is.null(x.range.split) & is.null(y.range.split)){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": AT LEAST ONE OF THE x.range.split AND y.range.split ARGUMENTS MUST BE NON NULL\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(x.range.split)){**

**tempo <- fun\_check(data = x.range.split, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & x.range.split < 1){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": x.range.split ARGUMENT CANNOT BE LOWER THAN 1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(y.range.split)){**

**tempo <- fun\_check(data = y.range.split, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.range.split < 1){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": y.range.split ARGUMENT CANNOT BE LOWER THAN 1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**tempo <- fun\_check(data = x.step.factor, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & x.step.factor < 1){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": x.step.factor ARGUMENT CANNOT BE LOWER THAN 1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = y.step.factor, class = "vector", mode = "numeric", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & y.step.factor < 1){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": y.step.factor ARGUMENT CANNOT BE LOWER THAN 1\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = error, prop = TRUE, length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(data2)){**

**if(is.null(x2) | is.null(y2)){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": x2 AND y2 ARGUMENTS CANNOT BE NULL IF data2 ARGUMENT IS NON NULL\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = data2, class = "data.frame", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & length(data2) < 2){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": data2 ARGUMENT MUST BE A DATA FRAME OF AT LEAST 2 COLUMNS\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**if( ! is.null(x2)){**

**tempo <- fun\_check(data = x2, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (x2 %in% names(data2))){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": x2 ARGUMENT MUST BE A COLUMN NAME OF data2\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & x2 %in% names(data2)){**

**tempo <- fun\_check(data = data2[, x2], data.name = "x2 COLUMN OF data2", class = "vector", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**}**

**if( ! is.null(y2)){**

**tempo <- fun\_check(data = y2, class = "vector", mode = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! (y2 %in% names(data2))){**

**cat(paste0("\n\n================\n\nERROR IN ", function.name, ": y2 ARGUMENT MUST BE A COLUMN NAME OF data2\n\n================\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & y2 %in% names(data2)){**

**tempo <- fun\_check(data = data2[, y2], data.name = "y2 COLUMN OF data2", class = "vector", mode = "numeric", na.contain = TRUE, fun.name = function.name) ; eval(ee)**

**}**

**}**

**}**

**if( ! is.null(data2)){**

**tempo <- fun\_check(data = data2.pb.dot, options = c("signif", "not.signif", "unknown"), length = 1, fun.name = function.name) ; eval(ee)**

**}**

**if( ! (is.null(x.range.split)) & ! (is.null(y.range.split))){**

**tempo <- fun\_check(data = xy.cross.kind, options = c("&", "|"), length = 1, fun.name = function.name) ; eval(ee)**

**}**

**tempo <- fun\_check(data = plot, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = warn.print, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & plot == TRUE){**

**tempo <- fun\_check(data = raster, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = graph.in.file, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & graph.in.file == TRUE & is.null(dev.list())){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \ngraph.in.file PARAMETER SET TO TRUE BUT NO ACTIVE GRAPHIC DEVICE DETECTED\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}else if(tempo$problem == FALSE & graph.in.file == TRUE & ! is.null(dev.list())){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": GRAPHS PRINTED IN THE CURRENT DEVICE (TYPE ", toupper(names(dev.cur())), ")")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# other required function checking*

**if(plot == TRUE){**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_open", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_open() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_palette", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_palette() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_empty\_graph", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_empty\_graph() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_gg\_scatter", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_gg\_scatter() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_close", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_close() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**}**

*# end other required function checking*

*# package checking*

**if(plot == TRUE){**

**fun\_pack(req.package = c("ggplot2"), path.lib = path.lib)**

**}**

*# end package checking*

*# main code*

*# na and Inf detection and removal (done now to be sure of the correct length of categ)*

**data1.removed.row.nb <- NULL**

**data1.removed.rows <- NULL**

**data2.removed.row.nb <- NULL**

**data2.removed.rows <- NULL**

**if(any(is.na(data1[, c(x1, y1)])) | any(is.infinite(data1[, x1])) | any(is.infinite(data1[, y1]))){**

**tempo.na <- unlist(lapply(lapply(c(data1[c(x1, y1)]), FUN = is.na), FUN = which))**

**tempo.inf <- unlist(lapply(lapply(c(data1[c(x1, y1)]), FUN = is.infinite), FUN = which))**

**data1.removed.row.nb <- sort(unique(c(tempo.na, tempo.inf)))**

**if(length(data1.removed.row.nb) > 0){**

**data1.removed.rows <- data1[data1.removed.row.nb, ]**

**}**

**if(length(data1.removed.row.nb) == nrow(data1)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": AT LEAST ONE NA, NaN, -Inf OR Inf DETECTED IN EACH ROW OF data1. FUNCTION CANNOT BE USED ON EMPTY DATA FRAME\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(length(data1.removed.row.nb) > 0){**

**data1 <- data1[-data1.removed.row.nb, ]**

**}**

**if(nrow(data1) == 0){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 1\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NA, NaN, -Inf OR Inf DETECTED IN COLUMN ", paste(c(x1, y1), collapse = " "), " OF data1 AND CORRESPONDING ROWS REMOVED (SEE $data1.removed.row.nb AND $data1.removed.rows)")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NO NA, NaN, -Inf OR Inf DETECTED IN COLUMN ", paste(c(x1, y1), collapse = " "), " OF data1. NO ROW REMOVED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**if( ! is.null(data2)){**

**if(any(is.na(data2[, c(x2, y2)])) | any(is.infinite(data2[, x2])) | any(is.infinite(data2[, y2]))){**

**tempo.na <- unlist(lapply(lapply(c(data2[c(x2, y2)]), FUN = is.na), FUN = which))**

**tempo.inf <- unlist(lapply(lapply(c(data2[c(x2, y2)]), FUN = is.infinite), FUN = which))**

**data2.removed.row.nb <- sort(unique(c(tempo.na, tempo.inf)))**

**if(length(data2.removed.row.nb) > 0){**

**data2.removed.rows <- data2[data2.removed.row.nb, ]**

**}**

**if(length(data2.removed.row.nb) == nrow(data2)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": AT LEAST ONE NA, NaN, -Inf OR Inf DETECTED IN EACH ROW OF data2. FUNCTION CANNOT BE USED ON EMPTY DATA FRAME\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(length(data2.removed.row.nb) > 0){**

**data2 <- data2[-data2.removed.row.nb, ]**

**}**

**if(nrow(data2) == 0){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 2\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NA, NaN, -Inf OR Inf DETECTED IN COLUMN ", paste(c(x2, y2), collapse = " "), " OF data2 AND CORRESPONDING ROWS REMOVED (SEE $data2.removed.row.nb AND $data2.removed.rows)")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}else{**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": NO NA, NaN, -Inf OR Inf DETECTED IN COLUMN ", paste(c(x2, y2), collapse = " "), " OF data2. NO ROW REMOVED")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

*# end na and Inf detection and removal (done now to be sure of the correct length of categ)*

*# row annotation (dot number)*

*# data1 <- data1[ ! duplicated(data1[, c(x1, y1)]), ] # do not remove the dots that have same x and y values, because they will have different dot number -> not the same position on the matrices (so true for symmetric matrices)*

**data1 <- cbind(data1, DOT\_NB = 1:nrow(data1))**

**if( ! is.null(data2)){**

*# data2 <- data2[ ! duplicated(data2[, c(x2, y2)]), ] # do not remove the dots that have same x and y values, because they will have different dot number -> not the same position on the matrices (so true for symmetric matrices)*

**data2 <- cbind(data2, DOT\_NB = 1:nrow(data2))**

**}**

*# end row annotation (dot number)*

*# Method using x unit interval*

*# may be create vector of each column to increase speed*

**x.data1.l <- NULL** *# x coord of the y upper and lower limits defined on the data1 cloud for left step line*

**x.data1.r <- NULL** *# x coord of the y upper and lower limits defined on the data1 cloud for right step line*

**y.data1.down.limit.l <- NULL** *# lower limit of the data1 cloud for left step line*

**y.data1.top.limit.l <- NULL** *# upper limit of the data1 cloud for left step line*

**y.data1.down.limit.r <- NULL** *# lower limit of the data1 cloud for right step line*

**y.data1.top.limit.r <- NULL** *# upper limit of the data1 cloud for left step line*

**if(any(data1[, x1] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data1 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE x1 COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**x.range <- range(data1[, x1], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**if(suppressWarnings(any(x.range %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED x.range CONTAINS Inf VALUES, BECAUSE VALUES FROM data1 ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(any(data1[, y1] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data1 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE y1 COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**y.range <- range(data1[, y1], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**if(suppressWarnings(any(x.range %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED y.range CONTAINS Inf VALUES, BECAUSE VALUES FROM data1 ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**x.range.plot <- range(data1[, x1], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**y.range.plot <- range(data1[, y1], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**if( ! is.null(data2)){**

**if(any(data2[, x2] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data2 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE x2 COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**x.range.plot <- range(data1[, x1], data2[, x2], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**if(any(data2[, y2] %in% c(Inf, -Inf))){**

**tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE data2 ARGUMENT CONTAINS -Inf OR Inf VALUES IN THE y2 COLUMN, THAT WILL NOT BE CONSIDERED IN THE PLOT RANGE")**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**y.range.plot <- range(data1[, y1], data2[, y2], na.rm = TRUE, finite = TRUE)** *# finite = TRUE removes all the -Inf and Inf except if only this. In that case, whatever the -Inf and/or Inf present, output -Inf;Inf range. Idem with NA only*

**}**

**if(suppressWarnings(any(x.range.plot %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED x.range.plot CONTAINS Inf VALUES, BECAUSE VALUES FROM data1 (AND data2?) ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(suppressWarnings(any(y.range.plot %in% c(Inf, -Inf)))){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, " COMPUTED y.range.plot CONTAINS Inf VALUES, BECAUSE VALUES FROM data1 (AND data2?) ARGUMENTS ARE NA OR Inf ONLY\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if( ! is.null(x.range.split)){**

*# data.frame ordering to slide the window from small to big values + sliding window definition*

**data1 <- data1[order(data1[, x1], na.last = TRUE), ]**

**if( ! is.null(data2)){**

**data2 <- data2[order(data2[, x2], na.last = TRUE), ]**

**}**

**x.win.size <- abs(diff(x.range) / x.range.split)** *# in unit of x-axis*

**step <- x.win.size / x.step.factor**

*# end data.frame ordering to slide the window from small to big values + sliding window definition*

*# x-axis sliding and y-axis limits of the data1 cloud -> y significant data2*

**loop.nb <- ceiling((diff(x.range) - x.win.size) / step)** *# x.win.size + n \* step covers the x range if x.win.size + n \* step >= diff(x.range), thus if n >= (diff(x.range) - x.win.size) / step*

**y.outside.data1.dot.nb <- integer()** *# vector that will contain the selected rows numbers of data1 that are upper or lower than the frame*

**y.inside.data1.dot.nb <- integer()** *# vector that will contain the selected rows numbers of data1 that are not upper or lower than the frame*

**y.data1.median <- median(data1[, y1], na.rm = TRUE)** *# will be used for sliding windows without data1 in it*

**if( ! is.null(data2)){**

**y.outside.data2.dot.nb <- integer()** *# vector that will contain the selected 1D coordinates (i.e., dots) of data2 that are upper or lower than the data1 frame*

**y.inside.data2.dot.nb <- integer()** *# vector that will contain the 1D coordinates (i.e., dots) of data2 that are not upper or lower than the data1 frame*

**y.unknown.data2.dot.nb <- integer()** *# vector that will contain the 1D coordinates (i.e., dots) of data2 that are problematic: data2 dots outside of the range of data1, or data2 dots in a sliding window without data1 dots*

*# recover data2 dots outside the range of data1*

**if(any(data2[, x2] < x.range[1])){**

**y.unknown.data2.dot.nb <- c(y.unknown.data2.dot.nb, data2$DOT\_NB[data2[, x2] < x.range[1]])**

**#tempo.warning & indicate the interval**

**}**

**if(any(data2[, x2] > x.range[2])){**

**y.unknown.data2.dot.nb <- c(y.unknown.data2.dot.nb, data2$DOT\_NB[data2[, x2] > x.range[2]])**

**#tempo.warning & indicate the interval**

**}**

*# end recover data2 dots outside the range of data1*

**}**

*# loop.ini.time <- as.numeric(Sys.time())*

**for(i1 in 0:(loop.nb + 1)){**

**min.pos <- x.range[1] + step \* i1** *# lower position of the sliding window in data1*

**max.pos <- min.pos + x.win.size** *# upper position of the sliding window in data1*

**x.data1.l <- c(x.data1.l, min.pos, min.pos + step)** *# min.pos + step to make the steps*

**x.data1.r <- c(x.data1.r, max.pos, max.pos + step)** *# max.pos + step to make the steps*

**x.data1.dot.here <- data1[, x1] >= min.pos & data1[, x1] < max.pos** *# is there data1 dot present in the sliding window, considering the x axis?*

**if( ! is.null(data2)){**

**x.data2.dot.here <- data2[, x2] >= min.pos & data2[, x2] < max.pos** *# is there data2 dot present in the sliding window, considering the x axis?*

**}**

*# recover the data1 dots outside the frame*

**if(any(x.data1.dot.here == TRUE)){**

**tempo.y.data1.top.limit <- quantile(data1[x.data1.dot.here, y1], probs = 1 - error, na.rm = TRUE)**

**tempo.y.data1.down.limit <- quantile(data1[x.data1.dot.here, y1], probs = 0 + error, na.rm = TRUE)**

**y.data1.top.limit.l <- c(y.data1.top.limit.l, tempo.y.data1.top.limit, tempo.y.data1.top.limit)**

**y.data1.down.limit.l <- c(y.data1.down.limit.l, tempo.y.data1.down.limit, tempo.y.data1.down.limit)**

**y.data1.top.limit.r <- c(y.data1.top.limit.r, tempo.y.data1.top.limit, tempo.y.data1.top.limit)**

**y.data1.down.limit.r <- c(y.data1.down.limit.r, tempo.y.data1.down.limit, tempo.y.data1.down.limit)**

**y.data1.dot.signif <- ( ! ((data1[, y1] <= tempo.y.data1.top.limit) & (data1[, y1] >= tempo.y.data1.down.limit))) & x.data1.dot.here** *# is there data1 dot present in the sliding window, above or below the data1 limits, considering the y axis?*

**y.data1.dot.not.signif <- x.data1.dot.here & ! y.data1.dot.signif**

**y.outside.data1.dot.nb <- c(y.outside.data1.dot.nb, data1$DOT\_NB[y.data1.dot.signif])** *# recover the row number of data1*

**y.outside.data1.dot.nb <- unique(y.outside.data1.dot.nb)**

**y.inside.data1.dot.nb <- c(y.inside.data1.dot.nb, data1$DOT\_NB[y.data1.dot.not.signif])**

**y.inside.data1.dot.nb <- unique(y.inside.data1.dot.nb)**

**}else{**

**y.data1.top.limit.l <- c(y.data1.top.limit.l, y.data1.median, y.data1.median)**

**y.data1.down.limit.l <- c(y.data1.down.limit.l, y.data1.median, y.data1.median)**

**y.data1.top.limit.r <- c(y.data1.top.limit.r, y.data1.median, y.data1.median)**

**y.data1.down.limit.r <- c(y.data1.down.limit.r, y.data1.median, y.data1.median)**

**}**

*# end recover the data1 dots outside the frame*

*# recover the data2 dots outside the frame*

**if( ! is.null(data2)){**

**if(any(x.data1.dot.here == TRUE) & any(x.data2.dot.here == TRUE)){**

**y.data2.dot.signif <- ( ! ((data2[, y2] <= tempo.y.data1.top.limit) & (data2[, y2] >= tempo.y.data1.down.limit))) & x.data2.dot.here** *# is there data2 dot present in the sliding window, above or below the data1 limits, considering the y axis?*

**y.data2.dot.not.signif <- x.data2.dot.here & ! y.data2.dot.signif**

**y.outside.data2.dot.nb <- c(y.outside.data2.dot.nb, data2$DOT\_NB[y.data2.dot.signif])**

**y.outside.data2.dot.nb <- unique(y.outside.data2.dot.nb)**

**y.inside.data2.dot.nb <- c(y.inside.data2.dot.nb, data2$DOT\_NB[y.data2.dot.not.signif])**

**y.inside.data2.dot.nb <- unique(y.inside.data2.dot.nb)**

**}else if(any(x.data1.dot.here == FALSE) & any(x.data2.dot.here == TRUE)){** *# problem: data2 dots in the the windows but no data1 dots to generates the quantiles*

**y.unknown.data2.dot.nb <- c(y.unknown.data2.dot.nb, data2$DOT\_NB[x.data2.dot.here])**

**y.unknown.data2.dot.nb <- unique(y.unknown.data2.dot.nb)**

**#tempo.warning & indicate the interval**

**# tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE [", round(min.pos, 3), " ; ", round(max.pos, 3), "] INTERVAL DOES NOT CONTAIN data1 X VALUES BUT CONTAINS data2 X VALUES WHICH CANNOT BE EVALUATED.\nTHE CONCERNED data2 ROW NUMBERS ARE:\n", paste(which(x.data1.dot.here == FALSE & x.data2.dot.here == TRUE), collapse = "\n"))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

*# end recover the data2 dots outside the frame*

*# if(any(i1 == seq(1, loop.nb, 500))){*

*# loop.fin.time <- as.numeric(Sys.time()) # time of process end*

*# cat(paste0("COMPUTATION TIME OF LOOP ", i1, " / ", loop.nb, ": ", as.character(lubridate::seconds\_to\_period(round(loop.fin.time - loop.ini.time))), "\n"))*

*# }*

**}**

**if(max.pos < x.range[2]){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE SLIDING WINDOW HAS NOT REACHED THE MAX VALUE OF data1 ON THE X-AXIS: ", max.pos, " VERSUS ", x.range[2], "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**y.incon.data1.dot.nb.final <- unique(c(y.outside.data1.dot.nb[y.outside.data1.dot.nb %in% y.inside.data1.dot.nb], y.inside.data1.dot.nb[y.inside.data1.dot.nb %in% y.outside.data1.dot.nb]))** *# inconsistent dots: if a row number of y.inside.data1.dot.nb is present in y.outside.data1.dot.nb (and vice versa), it means that during the sliding, a dot has been sometime inside, sometime outside -> removed from the outside list*

**y.outside.data1.dot.nb.final <- y.outside.data1.dot.nb[ ! (y.outside.data1.dot.nb %in% y.incon.data1.dot.nb.final)]** *# inconsistent dots removed from the outside list*

**y.inside.data1.dot.nb.final <- y.inside.data1.dot.nb[ ! (y.inside.data1.dot.nb %in% y.incon.data1.dot.nb.final)]** *# inconsistent dots removed from the inside list*

**if( ! is.null(data2)){**

*# if some unknown dots are also inside, and/or outside, they are put in the inside and/or outside. Ok, because then the intersection between inside and outside is treated -> inconsistent dots*

**tempo.unknown.out <- y.unknown.data2.dot.nb[y.unknown.data2.dot.nb %in% y.outside.data2.dot.nb]**

**y.outside.data2.dot.nb <- unique(c(y.outside.data2.dot.nb, tempo.unknown.out))** *# if a row number of y.unknown.data2.dot.nb is present in y.outside.data2.dot.nb, it is put into outside*

**tempo.unknown.in <- y.unknown.data2.dot.nb[y.unknown.data2.dot.nb %in% y.inside.data2.dot.nb]**

**y.inside.data2.dot.nb <- unique(c(y.inside.data2.dot.nb, tempo.unknown.in))** *# if a row number of y.unknown.data2.dot.nb is present in y.inside.data2.dot.nb, it is put into inside*

**y.unknown.data2.dot.nb.final <- y.unknown.data2.dot.nb[ ! (y.unknown.data2.dot.nb %in% c(y.outside.data2.dot.nb, y.inside.data2.dot.nb))]** *# then dots also in inside and outside are remove from unknown*

**y.incon.data2.dot.nb.final <- unique(c(y.outside.data2.dot.nb[y.outside.data2.dot.nb %in% y.inside.data2.dot.nb], y.inside.data2.dot.nb[y.inside.data2.dot.nb %in% y.outside.data2.dot.nb]))** *# inconsistent dots: if a row number of y.inside.data2.dot.nb is present in y.outside.data2.dot.nb (and vice versa), it means that during the sliding, a dot has been sometime inside, sometime outside -> removed from the outside list*

**y.outside.data2.dot.nb.final <- y.outside.data2.dot.nb[ ! (y.outside.data2.dot.nb %in% y.incon.data2.dot.nb.final)]** *# inconsistent dots removed from the outside list*

**y.inside.data2.dot.nb.final <- y.inside.data2.dot.nb[ ! (y.inside.data2.dot.nb %in% y.incon.data2.dot.nb.final)]** *# inconsistent dots removed from the inside list*

**}**

*# end x-axis sliding and y-axis limits of the data1 cloud -> y significant data2*

**}**

*# end Method using x unit interval*

*# Method using y unit interval*

**y.data1.d <- NULL** *# y coord of the x upper and lower limits defined on the data1 cloud for down step line*

**y.data1.t <- NULL** *# y coord of the x upper and lower limits defined on the data1 cloud for top step line*

**x.data1.left.limit.d <- NULL** *# left limit of the data1 cloud for down step line*

**x.data1.right.limit.d <- NULL** *# right limit of the data1 cloud for down step line*

**x.data1.left.limit.t <- NULL** *# left limit of the data1 cloud for top step line*

**x.data1.right.limit.t <- NULL** *# right limit of the data1 cloud for top step line*

**if( ! is.null(y.range.split)){**

*# data.frame ordering to slide the window from small to big values + sliding window definition*

**data1 <- data1[order(data1[, y1], na.last = TRUE), ]**

**if( ! is.null(data2)){**

**data2 <- data2[order(data2[, y2], na.last = TRUE), ]**

**}**

**y.win.size <- abs(diff(y.range) / y.range.split)** *# in unit of y-axis*

**step <- y.win.size / y.step.factor**

*# end data.frame ordering to slide the window from small to big values + sliding window definition*

*# y-axis sliding and x-axis limits of the data1 cloud -> x significant data2*

**loop.nb <- ceiling((diff(y.range) - y.win.size) / step)** *# y.win.size + n \* step covers the y range if y.win.size + n \* step >= diff(y.range), thus if n >= (diff(y.range) - y.win.size) / step*

**x.outside.data1.dot.nb <- integer()** *# vector that will contain the selected rows numbers of data1 that are upper or lower than the frame*

**x.inside.data1.dot.nb <- integer()** *# vector that will contain the selected rows numbers of data1 that are not upper or lower than the frame*

**x.data1.median <- median(data1[, x1], na.rm = TRUE)** *# will be used for sliding windows without data1 in it*

**if( ! is.null(data2)){**

**x.outside.data2.dot.nb <- integer()** *# vector that will contain the selected 1D coordinates (i.e., dots) of data2 that are upper or lower than the data1 frame*

**x.inside.data2.dot.nb <- integer()** *# vector that will contain the 1D coordinates (i.e., dots) of data2 that are not upper or lower than the data1 frame*

**x.unknown.data2.dot.nb <- integer()** *# vector that will contain the 1D coordinates (i.e., dots) of data2 that are problematic: data2 dots outside of the range of data1, or data2 dots in a sliding window without data1 dots*

*# recover data2 dots outside the range of data1*

**if(any(data2[, y2] < y.range[1])){**

**x.unknown.data2.dot.nb <- c(x.unknown.data2.dot.nb, data2$DOT\_NB[data2[, y2] < y.range[1]])**

**}**

**if(any(data2[, y2] > y.range[2])){**

**x.unknown.data2.dot.nb <- c(x.unknown.data2.dot.nb, data2$DOT\_NB[data2[, y2] > y.range[2]])**

**}**

*# end recover data2 dots outside the range of data1*

**}**

*# loop.ini.time <- as.numeric(Sys.time())*

**for(i1 in 0:(loop.nb + 1)){**

**min.pos <- y.range[1] + step \* i1** *# lower position of the sliding window in data1*

**max.pos <- min.pos + y.win.size** *# upper position of the sliding window in data1*

**y.data1.d <- c(y.data1.d, min.pos, min.pos + step)** *# min.pos + step to make the steps*

**y.data1.t <- c(y.data1.t, max.pos, max.pos + step)** *# max.pos + step to make the steps*

**y.data1.dot.here <- data1[, y1] >= min.pos & data1[, y1] < max.pos** *# is there data1 dot present in the sliding window, considering the y axis?*

**if( ! is.null(data2)){**

**y.data2.dot.here <- data2[, y2] >= min.pos & data2[, y2] < max.pos** *# is there data2 dot present in the sliding window, considering the y axis?*

**}**

*# recover the data1 dots outside the frame*

**if(any(y.data1.dot.here == TRUE)){**

**tempo.x.data1.right.limit <- quantile(data1[y.data1.dot.here, x1], probs = 1 - error, na.rm = TRUE)**

**tempo.x.data1.left.limit <- quantile(data1[y.data1.dot.here, x1], probs = 0 + error, na.rm = TRUE)**

**x.data1.right.limit.d <- c(x.data1.right.limit.d, tempo.x.data1.right.limit, tempo.x.data1.right.limit)**

**x.data1.left.limit.d <- c(x.data1.left.limit.d, tempo.x.data1.left.limit, tempo.x.data1.left.limit)**

**x.data1.right.limit.t <- c(x.data1.right.limit.t, tempo.x.data1.right.limit, tempo.x.data1.right.limit)**

**x.data1.left.limit.t <- c(x.data1.left.limit.t, tempo.x.data1.left.limit, tempo.x.data1.left.limit)**

**x.data1.dot.signif <- ( ! ((data1[, x1] <= tempo.x.data1.right.limit) & (data1[, x1] >= tempo.x.data1.left.limit))) & y.data1.dot.here** *# is there data2 dot present in the sliding window, above or below the data1 limits, considering the x axis?*

**x.data1.dot.not.signif <- y.data1.dot.here & ! x.data1.dot.signif**

**x.outside.data1.dot.nb <- c(x.outside.data1.dot.nb, data1$DOT\_NB[x.data1.dot.signif])** *# recover the row number of data1*

**x.outside.data1.dot.nb <- unique(x.outside.data1.dot.nb)**

**x.inside.data1.dot.nb <- c(x.inside.data1.dot.nb, data1$DOT\_NB[x.data1.dot.not.signif])**

**x.inside.data1.dot.nb <- unique(x.inside.data1.dot.nb)**

**}else{**

**x.data1.right.limit.d <- c(x.data1.right.limit.d, x.data1.median, x.data1.median)**

**x.data1.left.limit.d <- c(x.data1.left.limit.d, x.data1.median, x.data1.median)**

**x.data1.right.limit.t <- c(x.data1.right.limit.t, x.data1.median, x.data1.median)**

**x.data1.left.limit.t <- c(x.data1.left.limit.t, x.data1.median, x.data1.median)**

**}**

*# end recover the data1 dots outside the frame*

*# recover the data2 dots outside the frame*

**if( ! is.null(data2)){**

**if(any(y.data1.dot.here == TRUE) & any(y.data2.dot.here == TRUE)){**

**x.data2.dot.signif <- ( ! ((data2[, x2] <= tempo.x.data1.right.limit) & (data2[, x2] >= tempo.x.data1.left.limit))) & y.data2.dot.here** *# is there data2 dot present in the sliding window, above or below the data1 limits, considering the x axis?*

**x.data2.dot.not.signif <- y.data2.dot.here & ! x.data2.dot.signif**

**x.outside.data2.dot.nb <- c(x.outside.data2.dot.nb, data2$DOT\_NB[x.data2.dot.signif])**

**x.outside.data2.dot.nb <- unique(x.outside.data2.dot.nb)**

**x.inside.data2.dot.nb <- c(x.inside.data2.dot.nb, data2$DOT\_NB[x.data2.dot.not.signif])**

**x.inside.data2.dot.nb <- unique(x.inside.data2.dot.nb)**

**}else if(any(y.data1.dot.here == FALSE) & any(y.data2.dot.here == TRUE)){** *# recover the data2 dots outside the range of the data1 cloud*

**x.unknown.data2.dot.nb <- c(x.unknown.data2.dot.nb, data2$DOT\_NB[y.data2.dot.here])**

**x.unknown.data2.dot.nb <- unique(x.unknown.data2.dot.nb)**

**# tempo.warning <- paste0("FROM FUNCTION ", function.name, ": THE [", round(min.pos, 3), " ; ", round(max.pos, 3), "] INTERVAL DOES NOT CONTAIN data1 Y VALUES BUT CONTAINS data2 Y VALUES WHICH CANNOT BE EVALUATED.\nTHE CONCERNED data2 ROW NUMBERS ARE:\n", paste(which(y.data1.dot.here == FALSE & y.data2.dot.here == TRUE), collapse = "\n"))**

**warning <- paste0(ifelse(is.null(warning), tempo.warning, paste0(warning, "\n\n", tempo.warning)))**

**}**

**}**

*# end recover the data2 dots outside the frame*

*# if(any(i1 == seq(1, loop.nb, 500))){*

*# loop.fin.time <- as.numeric(Sys.time()) # time of process end*

*# cat(paste0("COMPUTATION TIME OF LOOP ", i1, " / ", loop.nb, ": ", as.character(lubridate::seconds\_to\_period(round(loop.fin.time - loop.ini.time))), "\n"))*

*# }*

**}**

**if(max.pos < y.range[2]){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": THE SLIDING WINDOW HAS NOT REACHED THE MAX VALUE OF data1 ON THE Y-AXIS: ", max.pos, " VERSUS ", y.range[2], "\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**x.incon.data1.dot.nb.final <- unique(c(x.outside.data1.dot.nb[x.outside.data1.dot.nb %in% x.inside.data1.dot.nb], x.inside.data1.dot.nb[x.inside.data1.dot.nb %in% x.outside.data1.dot.nb]))** *# inconsistent dots: if a row number of x.inside.data1.dot.nb is present in x.outside.data1.dot.nb (and vice versa), it means that during the sliding, a dot has been sometime inside, sometime outside -> removed from the outside list*

**x.outside.data1.dot.nb.final <- x.outside.data1.dot.nb[ ! (x.outside.data1.dot.nb %in% x.incon.data1.dot.nb.final)]** *# inconsistent dots removed from the outside list*

**x.inside.data1.dot.nb.final <- x.inside.data1.dot.nb[ ! (x.inside.data1.dot.nb %in% x.incon.data1.dot.nb.final)]** *# inconsistent dots removed from the inside list*

**if( ! is.null(data2)){**

*# if some unknown dots are also inside, and/or outside, they are put in the inside and/or outside. Ok, because then the intersection between inside and outside is treated -> inconsistent dots*

**tempo.unknown.out <- x.unknown.data2.dot.nb[x.unknown.data2.dot.nb %in% x.outside.data2.dot.nb]**

**x.outside.data2.dot.nb <- unique(c(x.outside.data2.dot.nb, tempo.unknown.out))** *# if a row number of x.unknown.data2.dot.nb is present in x.outside.data2.dot.nb, it is put into outside*

**tempo.unknown.in <- x.unknown.data2.dot.nb[x.unknown.data2.dot.nb %in% x.inside.data2.dot.nb]**

**x.inside.data2.dot.nb <- unique(c(x.inside.data2.dot.nb, tempo.unknown.in))** *# if a row number of x.unknown.data2.dot.nb is present in x.inside.data2.dot.nb, it is put into inside*

**x.unknown.data2.dot.nb.final <- x.unknown.data2.dot.nb[ ! (x.unknown.data2.dot.nb %in% c(x.outside.data2.dot.nb, x.inside.data2.dot.nb))]** *# then dots also in inside and outside are remove from unknown*

**x.incon.data2.dot.nb.final <- unique(c(x.outside.data2.dot.nb[x.outside.data2.dot.nb %in% x.inside.data2.dot.nb], x.inside.data2.dot.nb[x.inside.data2.dot.nb %in% x.outside.data2.dot.nb]))** *# inconsistent dots: if a row number of x.inside.data2.dot.nb is present in x.outside.data2.dot.nb (and vice versa), it means that during the sliding, a dot has been sometime inside, sometime outside -> removed from the outside list*

**x.outside.data2.dot.nb.final <- x.outside.data2.dot.nb[ ! (x.outside.data2.dot.nb %in% x.incon.data2.dot.nb.final)]** *# inconsistent dots removed from the outside list*

**x.inside.data2.dot.nb.final <- x.inside.data2.dot.nb[ ! (x.inside.data2.dot.nb %in% x.incon.data2.dot.nb.final)]** *# inconsistent dots removed from the inside list*

**}**

*# end y-axis sliding and x-axis limits of the data1 cloud -> x significant data2*

**}**

*# end Method using y unit interval*

*# recovering the frame coordinates*

**hframe = rbind(**

**data.frame(**

**x = if(is.null(x.data1.l)){NULL}else{x.data1.l},**

**y = if(is.null(x.data1.l)){NULL}else{y.data1.down.limit.l},**

**kind = if(is.null(x.data1.l)){NULL}else{"down.frame1"}**

**),**

**data.frame(**

**x = if(is.null(x.data1.r)){NULL}else{x.data1.r},**

**y = if(is.null(x.data1.r)){NULL}else{y.data1.down.limit.r},**

**kind = if(is.null(x.data1.r)){NULL}else{"down.frame2"}**

**),**

**data.frame(**

**x = if(is.null(x.data1.l)){NULL}else{x.data1.l},**

**y = if(is.null(x.data1.l)){NULL}else{y.data1.top.limit.l},**

**kind = if(is.null(x.data1.l)){NULL}else{"top.frame1"}**

**),**

**data.frame(**

**x = if(is.null(x.data1.r)){NULL}else{x.data1.r},**

**y = if(is.null(x.data1.r)){NULL}else{y.data1.top.limit.r},**

**kind = if(is.null(x.data1.r)){NULL}else{"top.frame2"}**

**)**

**)**

**vframe = rbind(**

**data.frame(**

**x = if(is.null(y.data1.d)){NULL}else{x.data1.left.limit.d},**

**y = if(is.null(y.data1.d)){NULL}else{y.data1.d},**

**kind = if(is.null(y.data1.d)){NULL}else{"left.frame1"}**

**),**

**data.frame(**

**x = if(is.null(y.data1.t)){NULL}else{x.data1.left.limit.t},**

**y = if(is.null(y.data1.t)){NULL}else{y.data1.t},**

**kind = if(is.null(y.data1.t)){NULL}else{"left.frame2"}**

**),**

**data.frame(**

**x = if(is.null(y.data1.d)){NULL}else{x.data1.right.limit.d},**

**y = if(is.null(y.data1.d)){NULL}else{y.data1.d},**

**kind = if(is.null(y.data1.d)){NULL}else{"right.frame1"}**

**),**

**data.frame(**

**x = if(is.null(y.data1.t)){NULL}else{x.data1.right.limit.t},**

**y = if(is.null(y.data1.t)){NULL}else{y.data1.t},**

**kind = if(is.null(y.data1.t)){NULL}else{"right.frame2"}**

**)**

**)**

*# end recovering the frame coordinates*

*# recovering the dot coordinates*

**data1.signif.dot <- NULL**

**data1.non.signif.dot <- NULL**

**data1.incon.dot <- NULL**

**data2.signif.dot <- NULL**

**data2.non.signif.dot <- NULL**

**data2.unknown.dot <- NULL**

**data2.incon.dot <- NULL**

**if(( ! is.null(x.range.split)) & ( ! is.null(y.range.split))){**

*# inconsistent dots recovery*

**if(length(unique(c(x.incon.data1.dot.nb.final, y.incon.data1.dot.nb.final))) > 0){**

**data1.incon.dot <- data1[data1$DOT\_NB %in% unique(c(x.incon.data1.dot.nb.final, y.incon.data1.dot.nb.final)), ]** *# if a dot in inconsistent in x or y -> classified as inconsistent (so unique() used)*

*# removal of the inconsistent dot in the other classifications*

**x.inside.data1.dot.nb.final <- x.inside.data1.dot.nb.final[ ! x.inside.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

**y.inside.data1.dot.nb.final <- y.inside.data1.dot.nb.final[ ! y.inside.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

**x.outside.data1.dot.nb.final <- x.outside.data1.dot.nb.final[ ! x.outside.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

**y.outside.data1.dot.nb.final <- y.outside.data1.dot.nb.final[ ! y.outside.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

**x.unknown.data1.dot.nb.final <- x.unknown.data1.dot.nb.final[ ! x.unknown.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

**y.unknown.data1.dot.nb.final <- y.unknown.data1.dot.nb.final[ ! y.unknown.data1.dot.nb.final %in% data1.incon.dot$DOT\_NB]**

*# end removal of the inconsistent dot in the other classifications*

**}**

**if( ! is.null(data2)){**

**if(length(unique(c(x.incon.data2.dot.nb.final, y.incon.data2.dot.nb.final))) > 0){**

**data2.incon.dot <- data2[data2$DOT\_NB %in% unique(c(x.incon.data2.dot.nb.final, y.incon.data2.dot.nb.final)), ]**

*# removal of the inconsistent dot in the other classifications*

**x.inside.data2.dot.nb.final <- x.inside.data2.dot.nb.final[ ! x.inside.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

**y.inside.data2.dot.nb.final <- y.inside.data2.dot.nb.final[ ! y.inside.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

**x.outside.data2.dot.nb.final <- x.outside.data2.dot.nb.final[ ! x.outside.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

**y.outside.data2.dot.nb.final <- y.outside.data2.dot.nb.final[ ! y.outside.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

**x.unknown.data2.dot.nb.final <- x.unknown.data2.dot.nb.final[ ! x.unknown.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

**y.unknown.data2.dot.nb.final <- y.unknown.data2.dot.nb.final[ ! y.unknown.data2.dot.nb.final %in% data2.incon.dot$DOT\_NB]**

*# end removal of the inconsistent dot in the other classifications*

**}**

**}**

*# end inconsistent dots recovery*

*# unknown dots recovery*

**if( ! is.null(data2)){**

**if(data2.pb.dot == "signif"){**

**x.outside.data2.dot.nb.final <- unique(c(x.outside.data2.dot.nb.final, x.unknown.data2.dot.nb.final))**

**x.inside.data2.dot.nb.final <- x.inside.data2.dot.nb.final[ ! x.inside.data2.dot.nb.final %in% x.unknown.data2.dot.nb.final]** *# remove x.unknown.data2.dot.nb.final from x.inside.data2.dot.nb.final*

**y.outside.data2.dot.nb.final <- unique(c(y.outside.data2.dot.nb.final, y.unknown.data2.dot.nb.final))**

**y.inside.data2.dot.nb.final <- y.inside.data2.dot.nb.final[ ! y.inside.data2.dot.nb.final %in% y.unknown.data2.dot.nb.final]** *# remove y.unknown.data2.dot.nb.final from y.inside.data2.dot.nb.final*

**x.unknown.data2.dot.nb.final <- NULL**

**y.unknown.data2.dot.nb.final <- NULL**

**data2.unknown.dot <- NULL**

**}else if(data2.pb.dot == "not.signif"){**

**x.inside.data2.dot.nb.final <- unique(c(x.inside.data2.dot.nb.final, x.unknown.data2.dot.nb.final))**

**x.outside.data2.dot.nb.final <- x.outside.data2.dot.nb.final[ ! x.outside.data2.dot.nb.final %in% x.unknown.data2.dot.nb.final]** *# remove x.unknown.data2.dot.nb.final from x.outside.data2.dot.nb.final*

**y.inside.data2.dot.nb.final <- unique(c(y.inside.data2.dot.nb.final, y.unknown.data2.dot.nb.final))**

**y.outside.data2.dot.nb.final <- y.outside.data2.dot.nb.final[ ! y.outside.data2.dot.nb.final %in% y.unknown.data2.dot.nb.final]** *# remove y.unknown.data2.dot.nb.final from y.outside.data2.dot.nb.final*

**x.unknown.data2.dot.nb.final <- NULL**

**y.unknown.data2.dot.nb.final <- NULL**

**data2.unknown.dot <- NULL**

**}else if(data2.pb.dot == "unknown"){**

**if(length(unique(c(x.unknown.data2.dot.nb.final, y.unknown.data2.dot.nb.final))) > 0){**

**data2.unknown.dot <- data2[data2$DOT\_NB %in% unique(c(x.unknown.data2.dot.nb.final, y.unknown.data2.dot.nb.final)), ]** *# if a dot in unknown in x or y -> classified as unknown (so unique() used)*

**x.outside.data2.dot.nb.final <- x.outside.data2.dot.nb.final[ ! x.outside.data2.dot.nb.final %in% data2.unknown.dot$DOT\_NB]** *# remove x.unknown.data2.dot.nb.final from x.outside.data2.dot.nb.final*

**x.inside.data2.dot.nb.final <- x.inside.data2.dot.nb.final[ ! x.inside.data2.dot.nb.final %in% data2.unknown.dot$DOT\_NB]** *# remove x.unknown.data2.dot.nb.final from x.inside.data2.dot.nb.final*

**y.outside.data2.dot.nb.final <- y.outside.data2.dot.nb.final[ ! y.outside.data2.dot.nb.final %in% data2.unknown.dot$DOT\_NB]** *# remove y.unknown.data2.dot.nb.final from y.outside.data2.dot.nb.final*

**y.inside.data2.dot.nb.final <- y.inside.data2.dot.nb.final[ ! y.inside.data2.dot.nb.final %in% data2.unknown.dot$DOT\_NB]** *# remove y.unknown.data2.dot.nb.final from y.inside.data2.dot.nb.final*

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 3\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end unknown dots recovery*

*# sign and non sign dot recovery*

**if(xy.cross.kind == "|"){** *# here the problem is to deal with significant dots depending on x and y. Thus I start with that, recover dots finally non significant in outside and put them in inside (when &), and remove from inside the dots in outside*

**if(length(unique(c(x.outside.data1.dot.nb.final, y.outside.data1.dot.nb.final))) > 0){**

**tempo.outside <- unique(c(x.outside.data1.dot.nb.final, y.outside.data1.dot.nb.final))** *# union so unique() used*

**tempo.inside <- unique(c(x.inside.data1.dot.nb.final, y.inside.data1.dot.nb.final))**

**tempo.inside <- tempo.inside[ ! tempo.inside %in% tempo.outside]**

**data1.signif.dot <- data1[data1$DOT\_NB %in% tempo.outside, ]**

**data1.non.signif.dot <- data1[data1$DOT\_NB %in% tempo.inside, ]**

**}else{**

**data1.non.signif.dot <- data1[unique(c(x.inside.data1.dot.nb.final, y.inside.data1.dot.nb.final)), ]** *# if no outside dots, I recover all the inside dots and that's it*

**}**

**}else if(xy.cross.kind == "&"){**

**if(sum(x.outside.data1.dot.nb.final %in% y.outside.data1.dot.nb.final) > 0){** *# that is intersection*

**tempo.outside <- unique(x.outside.data1.dot.nb.final[x.outside.data1.dot.nb.final %in% y.outside.data1.dot.nb.final])** *# intersection*

**tempo.outside.removed <- unique(c(x.outside.data1.dot.nb.final, y.outside.data1.dot.nb.final))[ ! unique(c(x.outside.data1.dot.nb.final, y.outside.data1.dot.nb.final)) %in% tempo.outside]**

**tempo.inside <- unique(c(x.inside.data1.dot.nb.final, y.inside.data1.dot.nb.final))**

**data1.signif.dot <- data1[data1$DOT\_NB %in% tempo.outside, ]**

**data1.non.signif.dot <- data1[data1$DOT\_NB %in% tempo.inside, ]**

**}else{**

**data1.non.signif.dot <- data1[unique(c(x.inside.data1.dot.nb.final, y.inside.data1.dot.nb.final)), ]** *# if no outside dots, I recover all the inside dots and that's it*

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 4\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if( ! is.null(data2)){**

**if(xy.cross.kind == "|"){** *# here the problem is to deal with significant dots depending on x and y. Thus I start with that, recover dots finally non significant in outside and put them in inside (when &), and remove from inside the dots in outside*

**if(length(unique(c(x.outside.data2.dot.nb.final, y.outside.data2.dot.nb.final))) > 0){**

**tempo.outside <- unique(c(x.outside.data2.dot.nb.final, y.outside.data2.dot.nb.final))** *# union so unique() used*

**tempo.inside <- unique(c(x.inside.data2.dot.nb.final, y.inside.data2.dot.nb.final))**

**tempo.inside <- tempo.inside[ ! tempo.inside %in% tempo.outside]**

**data2.signif.dot <- data2[data2$DOT\_NB %in% tempo.outside, ]**

**data2.non.signif.dot <- data2[data2$DOT\_NB %in% tempo.inside, ]**

**}else{**

**data2.non.signif.dot <- data2[unique(c(x.inside.data2.dot.nb.final, y.inside.data2.dot.nb.final)), ]** *# if no outside dots, I recover all the inside dots and that's it*

**}**

**}else if(xy.cross.kind == "&"){**

**if(sum(x.outside.data2.dot.nb.final %in% y.outside.data2.dot.nb.final) > 0){** *# that is intersection*

**tempo.outside <- unique(x.outside.data2.dot.nb.final[x.outside.data2.dot.nb.final %in% y.outside.data2.dot.nb.final])** *# intersection*

**tempo.outside.removed <- unique(c(x.outside.data2.dot.nb.final, y.outside.data2.dot.nb.final))[ ! unique(c(x.outside.data2.dot.nb.final, y.outside.data2.dot.nb.final)) %in% tempo.outside]**

**tempo.inside <- unique(c(x.inside.data2.dot.nb.final, y.inside.data2.dot.nb.final))**

**data2.signif.dot <- data2[data2$DOT\_NB %in% tempo.outside, ]**

**data2.non.signif.dot <- data2[data2$DOT\_NB %in% tempo.inside, ]**

**}else{**

**data2.non.signif.dot <- data2[unique(c(x.inside.data2.dot.nb.final, y.inside.data2.dot.nb.final)), ]** *# if no outside dots, I recover all the inside dots and that's it*

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 5\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end sign and non sign dot recovery*

**}else if(( ! is.null(x.range.split)) & is.null(y.range.split)){**

*# inconsistent dots recovery*

**if(length(y.incon.data1.dot.nb.final) > 0){**

**data1.incon.dot <- data1[data1$DOT\_NB %in% y.incon.data1.dot.nb.final, ]**

**}**

**if( ! is.null(data2)){**

**if(length(y.incon.data2.dot.nb.final) > 0){**

**data2.incon.dot <- data2[data2$DOT\_NB %in% y.incon.data2.dot.nb.final, ]**

**}**

**}***# end inconsistent dots recovery*

*# unknown dots recovery*

**if( ! is.null(data2)){**

**if(data2.pb.dot == "signif"){**

**y.outside.data2.dot.nb.final <- unique(c(y.outside.data2.dot.nb.final, y.unknown.data2.dot.nb.final))**

**}else if(data2.pb.dot == "not.signif"){**

**y.inside.data2.dot.nb.final <- unique(c(y.inside.data2.dot.nb.final, y.unknown.data2.dot.nb.final))**

**}else if(data2.pb.dot == "unknown"){**

**if(length(y.unknown.data2.dot.nb.final) > 0){**

**data2.unknown.dot <- data2[data2$DOT\_NB %in% y.unknown.data2.dot.nb.final, ]**

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 6\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end unknown dots recovery*

*# sign and non sign dot recovery*

**if(length(y.outside.data1.dot.nb.final) > 0){**

**data1.signif.dot <- data1[data1$DOT\_NB %in% y.outside.data1.dot.nb.final, ]**

**}**

**if(length(y.inside.data1.dot.nb.final) > 0){**

**data1.non.signif.dot <- data1[data1$DOT\_NB %in% y.inside.data1.dot.nb.final, ]**

**}**

**if( ! is.null(data2)){**

**if(length(y.outside.data2.dot.nb.final) > 0){**

**data2.signif.dot <- data2[data2$DOT\_NB %in% y.outside.data2.dot.nb.final, ]**

**}**

**if(length(y.inside.data2.dot.nb.final) > 0){**

**data2.non.signif.dot <- data2[data2$DOT\_NB %in% y.inside.data2.dot.nb.final, ]**

**}**

**}**

*# end sign and non sign dot recovery*

**}else if(is.null(x.range.split) & ( ! is.null(y.range.split))){**

*# inconsistent dots recovery*

**if(length(x.incon.data1.dot.nb.final) > 0){**

**data1.incon.dot <- data1[data1$DOT\_NB %in% x.incon.data1.dot.nb.final, ]**

**}**

**if( ! is.null(data2)){**

**if(length(x.incon.data2.dot.nb.final) > 0){**

**data2.incon.dot <- data2[data2$DOT\_NB %in% x.incon.data2.dot.nb.final, ]**

**}**

**}***# end inconsistent dots recovery*

*# unknown dots recovery*

**if( ! is.null(data2)){**

**if(data2.pb.dot == "signif"){**

**x.outside.data2.dot.nb.final <- unique(c(x.outside.data2.dot.nb.final, x.unknown.data2.dot.nb.final))**

**}else if(data2.pb.dot == "not.signif"){**

**x.inside.data2.dot.nb.final <- unique(c(x.inside.data2.dot.nb.final, x.unknown.data2.dot.nb.final))**

**}else if(data2.pb.dot == "unknown"){**

**if(length(x.unknown.data2.dot.nb.final) > 0){**

**data2.unknown.dot <- data2[data2$DOT\_NB %in% x.unknown.data2.dot.nb.final, ]**

**}**

**}else{**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 7\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end unknown dots recovery*

*# sign and non sign dot recovery*

**if(length(x.outside.data1.dot.nb.final) > 0){**

**data1.signif.dot <- data1[data1$DOT\_NB %in% x.outside.data1.dot.nb.final, ]**

**}**

**if(length(x.inside.data1.dot.nb.final) > 0){**

**data1.non.signif.dot <- data1[data1$DOT\_NB %in% x.inside.data1.dot.nb.final, ]**

**}**

**if( ! is.null(data2)){**

**if(length(x.outside.data2.dot.nb.final) > 0){**

**data2.signif.dot <- data2[data2$DOT\_NB %in% x.outside.data2.dot.nb.final, ]**

**}**

**if(length(x.inside.data2.dot.nb.final) > 0){**

**data2.non.signif.dot <- data2[data2$DOT\_NB %in% x.inside.data2.dot.nb.final, ]**

**}**

**}**

*# end sign and non sign dot recovery*

**}**

*# end recovering the dot coordinates*

*# verif*

**if(any(data1.signif.dot$DOT\_NB %in% data1.non.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", FUNCTION.NAME, ": CODE INCONSISTENCY 8\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data1.non.signif.dot$DOT\_NB %in% data1.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", FUNCTION.NAME, ": CODE INCONSISTENCY 9\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data1.signif.dot$DOT\_NB %in% data1.incon.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 10\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data1.incon.dot$DOT\_NB %in% data1.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 11\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data1.non.signif.dot$DOT\_NB %in% data1.incon.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 12\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data1.incon.dot$DOT\_NB %in% data1.non.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 13\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if( ! is.null(data2)){**

**if(any(data2.signif.dot$DOT\_NB %in% data2.non.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 14\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.non.signif.dot$DOT\_NB %in% data2.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 15\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.signif.dot$DOT\_NB %in% data2.unknown.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 16\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.unknown.dot$DOT\_NB %in% data2.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 17\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.signif.dot$DOT\_NB %in% data2.incon.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 18\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.incon.dot$DOT\_NB %in% data2.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 19\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.non.signif.dot$DOT\_NB %in% data2.unknown.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 20\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.unknown.dot$DOT\_NB %in% data2.non.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 21\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.non.signif.dot$DOT\_NB %in% data2.incon.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 22\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.incon.dot$DOT\_NB %in% data2.non.signif.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 23\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.unknown.dot$DOT\_NB %in% data2.incon.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 24\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**if(any(data2.incon.dot$DOT\_NB %in% data2.unknown.dot$DOT\_NB)){**

**tempo.cat <- (paste0("\n\n============\n\nERROR IN ", function.name, ": CODE INCONSISTENCY 25\n\n============\n\n"))**

**stop(tempo.cat)**

**}**

**}**

*# end verif*

*# plot*

*# recovering the axes data whatever plot or not*

**if(is.null(data2)){**

**axes <- fun\_gg\_scatter(data1 = list(data1), x = list(x1), y = list(y1), categ = list(NULL), color = list(fun\_gg\_palette(2)[2]), geom = list("geom\_point"), alpha = list(0.5), xlim = x.range.plot, ylim = y.range.plot, raster = raster, plot = FALSE, return = TRUE)$axes**

**}else{**

**axes <- fun\_gg\_scatter(data1 = list(data1, data2), x = list(x1, x2), y = list(y1, y2), categ = list(NULL, NULL), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1]), geom = list("geom\_point", "geom\_point"), alpha = list(0.5, 0.5), xlim = x.range.plot, ylim = y.range.plot, raster = raster, plot = FALSE, return = TRUE)$axes**

**}**

*# end recovering the axes data whatever plot or not*

**if(plot == TRUE){**

*# add a categ for plot legend*

**tempo.df.name <- c("data1", "data1.signif.dot", "data1.incon.dot", "data2", "data2.signif.dot", "data2.unknown.dot", "data2.incon.dot")**

**tempo.class.name <- c("data1", "data1", "data1", "data2", "data2", "data2", "data2")**

**for(i2 in 1:length(tempo.df.name)){**

**if( ! is.null(get(tempo.df.name[i2]))){**

**assign(tempo.df.name[i2], data.frame(get(tempo.df.name[i2]), kind = tempo.class.name[i2]))**

**}**

**}**

*# end add a categ for plot legend*

**if(( ! is.null(x.range.split)) & ( ! is.null(y.range.split))){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe, vframe), x = list(x1, "x", "x"), y = list(y1, "y", "y"), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME" , "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_path", "geom\_path"), alpha = list(0.5, 0.5, 0.5), title = "DATA1", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data1.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe, vframe, data1.signif.dot), x = list(x1, "x", "x", x1), y = list(y1, "y", "y", y1), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME" , "VERT FRAME", "SIGNIF DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2), "black"), geom = list("geom\_point", "geom\_path", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA1 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA1 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data1.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe, vframe, data1.incon.dot), x = list(x1, "x", "x", x1), y = list(y1, "y", "y", y1), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME" , "VERT FRAME", "INCONSISTENT DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2), fun\_gg\_palette(7)[6]), geom = list("geom\_point", "geom\_path", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA1 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 INCONSISTENT DOTS", text.size = 12, title = "DATA1 + DATA1 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, hframe , vframe), x = list(x1, x2, "x", "x"), y = list(y1, y2, "y", "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "HORIZ FRAME" , "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_path", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data2.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.signif.dot, hframe , vframe), x = list(x1, x2, x2, "x", "x"), y = list(y1, y2, y2, "y", "y"), categ = list("kind", "kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "SIGNIF DOTS", "HORIZ FRAME" , "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], "black", rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data2.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.incon.dot, hframe , vframe), x = list(x1, x2, x2, "x", "x"), y = list(y1, y2, y2, "y", "y"), categ = list("kind", "kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "INCONSISTENT DOTS", "HORIZ FRAME" , "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[6], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 INCONSISTENT DOTS", text.size = 12, title = "DATA2 + DATA2 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2.unknown.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.unknown.dot, hframe , vframe), x = list(x1, x2, x2, "x", "x"), y = list(y1, y2, y2, "y", "y"), categ = list("kind", "kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "UNKNOWN DOTS", "HORIZ FRAME" , "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[5], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 UNKNOWN DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 UNKNOWN DOTS", text.size = 12, title = "DATA2 + DATA2 UNKNOWN DOTS")**

**}**

**}**

**}else if(( ! is.null(x.range.split)) & is.null(y.range.split)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe), x = list(x1, "x"), y = list(y1, "y"), categ = list("kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2)), geom = list("geom\_point", "geom\_path"), alpha = list(0.5, 0.5), title = "DATA1", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data1.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe, data1.signif.dot), x = list(x1, "x", x1), y = list(y1, "y", y1), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME", "SIGNIF DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), "black"), geom = list("geom\_point", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA1 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA1 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data1.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, hframe, data1.incon.dot), x = list(x1, "x", x1), y = list(y1, "y", y1), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "HORIZ FRAME", "INCONSISTENT DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2), fun\_gg\_palette(7)[6]), geom = list("geom\_point", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA1 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 INCONSISTENT DOTS", text.size = 12, title = "DATA1 + DATA1 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, hframe), x = list(x1, x2, "x"), y = list(y1, y2, "y"), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "HORIZ FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA2", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data2.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.signif.dot, hframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "SIGNIF DOTS", "HORIZ FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], "black", rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data2.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.incon.dot, hframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "INCONSISTENT DOTS", "HORIZ FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[6], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 INCONSISTENT DOTS", text.size = 12, title = "DATA2 + DATA2 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2.unknown.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.unknown.dot, hframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "UNKNOWN DOTS", "HORIZ FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[5], rep(hsv(h = c(0.1, 0.15), v = c(0.75, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 UNKNOWN DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 UNKNOWN DOTS", text.size = 12, title = "DATA2 + DATA2 UNKNOWN DOTS")**

**}**

**}**

**}else if(is.null(x.range.split) & ( ! is.null(y.range.split))){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, vframe), x = list(x1, "x"), y = list(y1, "y"), categ = list("kind", "kind"), legend.name = list("DATASET", "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_path"), alpha = list(0.5, 0.5), title = "DATA1", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data1.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, vframe, data1.signif.dot), x = list(x1, "x", x1), y = list(y1, "y", y1), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "VERT FRAME", "SIGNIF DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2), "black"), geom = list("geom\_point", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA1 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA1 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data1.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, vframe, data1.incon.dot), x = list(x1, "x", x1), y = list(y1, "y", y1), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "VERT FRAME", "INCONSISTENT DOTS"), color = list(fun\_gg\_palette(2)[2], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2), fun\_gg\_palette(7)[6]), geom = list("geom\_point", "geom\_path", "geom\_point"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA1 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA1 INCONSISTENT DOTS", text.size = 12, title = "DATA1 + DATA1 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, vframe), x = list(x1, x2, "x"), y = list(y1, y2, "y"), categ = list("kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5), title = "DATA1 + DATA2", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**if( ! is.null(data2.signif.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.signif.dot, vframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "SIGNIF DOTS", "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], "black", rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 DOTS OUTSIDE THE FRAMES", text.size = 12, title = "DATA1 + DATA2 + DATA2 SIGNIFICANT DOTS")**

**}**

**if( ! is.null(data2.incon.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.incon.dot, vframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "INCONSISTENT DOTS", "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[6], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 INCONSISTENT DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 INCONSISTENT DOTS", text.size = 12, title = "DATA2 + DATA2 INCONSISTENT DOTS")**

**}**

**if( ! is.null(data2.unknown.dot)){**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**tempo.graph <- fun\_gg\_scatter(data1 = list(data1, data2, data2.unknown.dot, vframe), x = list(x1, x2, x2, "x"), y = list(y1, y2, y2, "y"), categ = list("kind", "kind", "kind", "kind"), legend.name = list("DATASET", "DATASET", "UNKNOWN DOTS", "VERT FRAME"), color = list(fun\_gg\_palette(2)[2], fun\_gg\_palette(2)[1], fun\_gg\_palette(7)[5], rep(hsv(h = c(0.5, 0.6), v = c(0.9, 1)), 2)), geom = list("geom\_point", "geom\_point", "geom\_point", "geom\_path"), alpha = list(0.5, 0.5, 0.5, 0.5), title = "DATA1 + DATA2 + DATA2 UNKNOWN DOTS", xlim = x.range.plot, ylim = y.range.plot, raster = raster, return = TRUE)**

**if( ! is.null(tempo.graph$warnings)){**

**warning <- paste0(ifelse(is.null(warning), tempo.graph$warnings, paste0(warning, "\n", tempo.graph$warnings)))**

**}**

**}else{**

**if(graph.in.file == FALSE){**

**fun\_open(pdf.disp = FALSE)**

**}**

**fun\_gg\_empty\_graph(text = "NO PLOT BECAUSE NO DATA2 UNKNOWN DOTS", text.size = 12, title = "DATA2 + DATA2 UNKNOWN DOTS")**

**}**

**}**

**}**

**}**

*# end plot*

**if(warn.print == TRUE & ! is.null(warning)){**

**warning(warning)**

**}**

**tempo.list <- list(data1.removed.row.nb = data1.removed.row.nb, data1.removed.rows = data1.removed.rows, data2.removed.row.nb = data2.removed.row.nb, data2.removed.rows = data2.removed.rows, hframe = hframe, vframe = vframe, data1.signif.dot = data1.signif.dot, data1.non.signif.dot = data1.non.signif.dot, data1.inconsistent.dot = data1.incon.dot, data2.signif.dot = data2.signif.dot, data2.non.signif.dot = data2.non.signif.dot, data2.unknown.dot = data2.unknown.dot, data2.inconsistent.dot = data2.incon.dot, axes = axes, warnings = warning)**

**return(tempo.list)**

**}**

################ Import

######## fun\_pack() #### check if R packages are present and import into the working environment

**# Check OK: clear to go Apollo**

**fun\_pack <- function(req.package, load = FALSE, path.lib = NULL){**

*# AIM*

*# check if the specified R packages are present in the computer and import them into the working environment*

*# ARGUMENTS*

*# req.package: character vector of package names to import*

*# req.package: logical. Load the package into the environement (using library())?*

*# path.lib: optional character vector specifying the absolute pathways of the directories containing some of the listed packages*

*# REQUIRED PACKAGES*

*# none*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# RETURN*

*# nothing*

*# EXAMPLES*

*# fun\_pack(req.package = "nopackage")*

*# fun\_pack(req.package = "ggplot2")*

*# fun\_pack(req.package = "ggplot2", path.lib = "blablabla")*

*# DEBUGGING*

*# req.package = "ggplot2" ; path.lib = "C:/Program Files/R/R-3.5.1/library"*

*# req.package = "serpentine" ; path.lib = "C:/users/gael/appdata/roaming/python/python36/site-packages"*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = req.package, class = "vector", mode = "character", fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = load, class = "vector", mode = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# main code*

**if(is.null(path.lib)){**

**path.lib <- .libPaths()** *# .libPaths(new = path.lib) # or .libPaths(new = c(.libPaths(), path.lib))*

**}else{**

**.libPaths(new = sub(x = path.lib, pattern = "/$|\\\\$", replacement = ""))** *# .libPaths(new = ) add path to default path. BEWARE: .libPaths() does not support / at the end of a submitted path. Thus check and replace last / or \\ in path*

**}**

**for(i0 in 1:length(req.package)){**

**if( ! req.package[i0] %in% rownames(installed.packages(lib.loc = path.lib))){**

**stop(paste0("\n\n================\n\nERROR IN ", function.name, ": PACKAGE ", req.package[i0], " MUST BE INSTALLED IN:\n", paste(path.lib, collapse = "\n"), "\n\n================\n\n"))**

**}else{**

**if(load == TRUE){**

**suppressWarnings(suppressPackageStartupMessages(library(req.package[i0], lib.loc = path.lib, quietly = TRUE, character.only = TRUE)))**

**}**

**}**

**}**

**}**

######## fun\_python\_pack() #### check if python packages are present

**# Check OK: clear to go Apollo**

**fun\_python\_pack <- function(req.package, path.lib = NULL, R.path.lib = NULL){**

*# AIM*

*# check if the specified python packages are present in the computer (no import)*

*# ARGUMENTS*

*# req.package: character vector of package names to import*

*# path.lib: optional character vector specifying the absolute pathways of the directories containing some of the listed packages*

*# R.path.lib: absolute path of the required packages, if not in the default folders*

*# REQUIRED PACKAGES*

*# reticulate*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# fun\_pack()*

*# RETURN*

*# nothing*

*# EXAMPLES*

*# fun\_python\_pack(req.package = "nopackage")*

*# fun\_python\_pack(req.package = "serpentine")*

*# fun\_python\_pack(req.package = "serpentine", path.lib = "blablabla")*

*# DEBUGGING*

*# req.package = "serpentine" ; path.lib = NULL ; R.path.lib = NULL*

*# req.package = "bad" ; path.lib = NULL ; R.path.lib = NULL*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

**if(length(find("fun\_pack", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_pack() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = req.package, class = "character", fun.name = function.name) ; eval(ee)**

**if( ! is.null(path.lib)){**

**tempo <- fun\_check(data = path.lib, class = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE path.lib PARAMETER DOES NOT EXISTS: ", path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if( ! is.null(R.path.lib)){**

**tempo <- fun\_check(data = R.path.lib, class = "character", fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & ! all(dir.exists(R.path.lib))){**

**cat(paste0("\n\n============\n\nERROR IN ", function.name, ": \nDIRECTORY PATH INDICATED IN THE R.path.lib PARAMETER DOES NOT EXISTS: ", R.path.lib, "\n\n============\n\n"))**

**arg.check <- c(arg.check, TRUE)**

**}**

**}**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# end argument checking*

*# package checking*

**fun\_pack(req.package = "reticulate", path.lib = R.path.lib)**

*# end package checking*

*# main code*

**if(is.null(path.lib)){**

**path.lib <- reticulate::py\_run\_string("**

**import sys ;**

**path\_lib = sys.path**

**")** *# python string*

**path.lib <- path.lib$path\_lib**

**}**

**for(i0 in 1:length(req.package)){**

**tempo.try <- vector("list", length = length(path.lib))**

**for(i1 in 1:length(path.lib)){**

**tempo.try[[i1]] <- suppressWarnings(try(reticulate::import\_from\_path(req.package[i0], path = path.lib[i1]), silent = TRUE))**

**}**

**if(all(sapply(tempo.try, FUN = grepl, pattern = "[Ee]rror"))){**

**stop(paste0("\n\n================\n\nERROR IN ", function.name, ": PACKAGE ", req.package[i0], " MUST BE INSTALLED IN THE MENTIONNED DIRECTORY:\n", paste(path.lib, collapse = "\n"), "\n\n================\n\n"))**

**}else{**

**# suppressWarnings(suppressPackageStartupMessages(assign(req.package[i0], reticulate::import(req.package[i0]))))** *# not required because try() already evaluates*

**}**

**}**

**}**

################ Exporting results (text & tables)

######## fun\_report() #### print string or data object into output file

**# Check OK: clear to go Apollo**

**fun\_report <- function(data = NULL, output ="results.txt", path = "C:/Users/Gael/Desktop", no.overwrite = TRUE, rownames.kept = FALSE, vector.cat = FALSE, noquote = TRUE, sep = 2){**

*# AIM*

*# log file function: print a character string or a data object into a same output file*

*# REQUIRED FUNCTIONS FROM CUTE\_LITTLE\_R\_FUNCTION*

*# fun\_check()*

*# ARGUMENTS*

*# data: object to print in the output file. cannot be NULL*

*# output: name of the output file*

*# path: location of the output file*

*# no.overwrite: (logical) if output file already exists, defines if the printing is appended (default TRUE) or if the output file content is erased before printing (FALSE)*

*# rownames.kept: (logical) defines whether row names have to be removed or not in small tables (less than length.rows rows)*

*# vector.cat (logical). If TRUE print a vector of length > 1 using cat() instead of capture.output(). Otherwise (default FALSE) the opposite*

*# noquote: (logical). If TRUE no quote are present for the characters*

*# sep: number of separating lines after printed data (must be integer)*

*# RETURN*

*# nothing*

*# EXAMPLES*

*# fun\_report()*

*# fun\_report(data = 1:3, output = "results.txt", path = "C:/Users/Gael/Desktop", no.overwrite = TRUE, rownames.kept = FALSE, vector.cat = FALSE, noquote = FALSE, sep = 2)*

*# DEBUGGING*

*# data = 1:3 ; output = "results.txt" ; path = "C:/Users/Gael/Desktop" ; no.overwrite = TRUE ; rownames.kept = FALSE ; vector.cat = FALSE ; noquote = FALSE ; sep = 2 # for function debugging*

*# function name*

**function.name <- paste0(as.list(match.call(expand.dots=FALSE))[[1]], "()")**

*# end function name*

*# required function checking*

**if(length(find("fun\_check", mode = "function")) == 0){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": REQUIRED fun\_check() FUNCTION IS MISSING IN THE R ENVIRONMENT\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end required function checking*

*# argument checking*

*# argument checking without fun\_check()*

**if(is.null(data)){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": data ARGUMENT CANNOT BE NULL\n\n================\n\n")**

**stop(tempo.cat)**

**}**

*# end argument checking without fun\_check()*

*# argument checking with fun\_check()*

**arg.check <- NULL** *# for function debbuging*

**checked.arg.names <- NULL** *# for function debbuging: used by r\_debugging\_tools*

**ee <- expression(arg.check <- c(arg.check, tempo$problem) , checked.arg.names <- c(checked.arg.names, tempo$param.name))**

**tempo <- fun\_check(data = output, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & output == ""){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": output ARGUMENT AS \"\" DOES NOT CORRESPOND TO A VALID FILE NAME\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = path, class = "character", length = 1, fun.name = function.name) ; eval(ee)**

**if(tempo$problem == FALSE & dir.exists(path) == FALSE){**

**tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": path ARGUMENT DOES NOT CORRESPOND TO EXISTING DIRECTORY\n", paste(path, collapse = "\n"),"\n\n================\n\n")**

**cat(tempo.cat)**

**arg.check <- c(arg.check, TRUE)**

**}**

**tempo <- fun\_check(data = no.overwrite, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = rownames.kept, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = vector.cat, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = noquote, class = "logical", length = 1, fun.name = function.name) ; eval(ee)**

**tempo <- fun\_check(data = sep, class = "vector", typeof = "integer", length = 1, double.as.integer.allowed = TRUE, fun.name = function.name) ; eval(ee)**

**if(any(arg.check) == TRUE){**

**stop()** *# nothing else because print = TRUE by default in fun\_check()*

**}**

*# end argument checking with fun\_check()*

*# source("C:/Users/Gael/Documents/Git\_versions\_to\_use/debugging\_tools\_for\_r\_dev-v1.2/r\_debugging\_tools-v1.2.R") ; eval(parse(text = str\_basic\_arg\_check\_dev)) ; eval(parse(text = str\_arg\_check\_with\_fun\_check\_dev)) # activate this line and use the function (with no arguments left as NULL) to check arguments status and if they have been checked using fun\_check()*

*# the 4 next lines are inactivated but kept because at a time, I might have a problem with data (solved with data = NULL). These 4 lines are just to know how to detect a missing argument. Important here because if data is not provided, print the code of the data function*

**# arg.user.list <- as.list(match.call(expand.dots=FALSE))[-1]** *# recover all the arguments provided by the function user (excluding the argument with defaults values not provided by the user. Thus, it is really the list indicated by the user)*

**# default.arg.list <- formals(fun = sys.function(sys.parent()))** *# list of all the arguments of the function with their default values (not the values of the user !). It seems that ls() as first line of the function provide the names of the arguments (empty, called, etc., or not)*

**# arg.without.default.value <- sapply(default.arg.list, is.symbol) & sapply(sapply(default.arg.list, as.character), identical, "")** *# logical to detect argument without default values (these are typeof "symbol" and class "name" and empty character*

**# if( ! all(names(default.arg.list)[arg.without.default.value] %in% names(arg.user.list))){** *# test that the arguments with no null values are provided by the user*

**# tempo.cat <- paste0("\n\n================\n\nERROR IN ", function.name, ": VALUE REQUIRED FOR THESE ARGUMENTS WITH NO DEFAULTS VALUES: ", paste(names(default.arg.list)[arg.without.default.value][ ! names(default.arg.list)[arg.without.default.value] %in% names(arg.user.list)], collapse = " "), "\n\n================\n\n")**

**#stop(tempo.cat)**

**# }**

*# end argument checking*

*# main code*

**if(all(class(data) %in% c("matrix", "data.frame", "table"))){**

**if(rownames.kept == FALSE & all(class(data) == "data.frame") & nrow(data) != 0 & nrow(data) <= 4){** *# for data frames with nrows <= 4*

**rownames.output.tables <- ""**

**length.rows <- nrow(data)**

**for(i in 1:length.rows){** *# replace the rownames of the first 4 rows by increasing number of spaces (because identical row names not allowed in data frames). This method cannot be extended to more rows as the printed data frame is shifted on the right because of "big empty rownames"*

**rownames.output.tables <- c(rownames.output.tables, paste0(rownames.output.tables[i]," ", collapse=""))**

**}**

**row.names(data) <- rownames.output.tables[1:length.rows]**

**}else if(rownames.kept == FALSE & all(class(data) %in% c("matrix", "table"))){**

**rownames(data) <- rep("", nrow(data))** *# identical row names allowed in matrices and tables*

**}**

**if(noquote == TRUE){**

**capture.output(noquote(data), file=paste0(path, "/", output), append = no.overwrite)**

**}else{**

**capture.output(data, file=paste0(path, "/", output), append = no.overwrite)**

**}**

**}else if(is.vector(data) & all(class(data) != "list") & (length(data) == 1 | vector.cat == TRUE)){**

**if(noquote == TRUE){**

**cat(noquote(data), file= paste0(path, "/", output), append = no.overwrite)**

**}else{**

**cat(data, file= paste0(path, "/", output), append = no.overwrite)**

**}**

**}else{** *# other (array, list, factor or vector with vector.cat = FALSE)*

**if(noquote == TRUE){**

**capture.output(noquote(data), file=paste0(path, "/", output), append = no.overwrite)**

**}else{**

**capture.output(data, file=paste0(path, "/", output), append = no.overwrite)**

**}**

**}**

**sep.final <- paste0(rep("\n", sep), collapse = "")**

**write(sep.final, file= paste0(path, "/", output), append = TRUE)** *# add a sep*

**}**