Circos plot

THis is a markdown file of the CD160 Circos plot code

Functions: - Count the usage of Vh, VD and Vj frequency of the heavy chain - draw the circos plot

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library(circlize) library(migest) library(dplyr) #filename <- "igH_prePCR.txt" #filename <- "igH_postPCR.txt" filename <- "VH-VK-Pan1-s.txt"

my_data <- read.csv(filename, sep="", header=TRUE)

head(my_data)

names(my_data)[1:5] <- c("count","frequency","vgene","jgene", "vj")

function: head(my_data)

my_data$frequency <- -my_data$frequency * 10000

dim(my_data)

summary(my_data)

summary(my_data$count)

c("1_Active_Promoter","4_Strong_Enhancer","8_Insulator"),]

m <- data.frame(order = 1:34, country = c("IgHV1", "IgHV2", "IgHV3", "IgHV4", "IgHV5", "IgHV6", "IgHV7", "IgHV8", "IgHV9", "IgHV10", "IgHV11","IgHV12", "IgHV15", "IgKV1", "IgKV2", "IgKV3", "IgKV4", "IgKV5", "IgKV6", "IgKV7", "IgKV8", "IgKV9", "IgKV10", "IgKV12", "IgKV13","IgKV14", "IgKV15", "IgKV16", "IgKV17", "IgKV18", "IgKV19", "IgKV20","IgKV21", "IgKV22"), IGHV1= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,sum(my_data[my_data$vj %in% c("IGHV1-IGKV1"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV2"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV3"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV4"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV5"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV6"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV7"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV8"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV9"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV10"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV12"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV13"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV14"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV15"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV16"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV17"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV18"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV19"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV20"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV21"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV1-IGKV22"),]$frequency)+0.0000001), $IGHV2 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data$vj %in% c("IGHV2-IGKV1"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV2"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV3"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV4"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV5"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV6"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV7"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV8"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV9"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV10"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV12"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV13"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV14"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV15"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV16"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV17"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV18"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV19"),]$frequency)+0.0000001, sum(my_data[my_data$vj %in% c("IGHV2-IGKV20"),]$frequency)+

$0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV2-IGKV21”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV2-IGKV22”),}]frequency)+0.0000001), IGHV3 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV1”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV2”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV3”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV4”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV5”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV6”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV7”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV8”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV9”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV10”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV12”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV13”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV14”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV15”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV16”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV17”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV18”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV19”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV20”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV21”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV3-IGKV22”),}]frequency) + 0.0000001), IGHV4 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV1”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV2”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV3”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV4”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV5”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV6”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV7”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV8”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV9”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV10”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV12”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV13”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV14”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV15”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV16”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV17”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV18”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV19”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV20”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV21”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV4-IGKV22”),}]frequency)+0.0000001), IGHV5 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV1”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV2”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV3”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV4”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV5”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV6”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV7”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV8”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV9”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV10”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV12”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV13”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV14”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV15”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV16”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV17”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV18”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV19”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV20”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV21”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV5-IGKV22”),}]frequency)+0.0000001), IGHV6 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV1”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV2”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV3”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV4”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV5”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV6”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV7”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV8”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV9”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV10”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV12”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV13”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV14”),}]frequency)+0.0000001, sum(my_data[my_data\text{avj } \%\text{in}\% \text{ c(“IGHV6-IGKV15”),}]frequency)+$

$0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV16"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV17"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV18"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV19"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV20"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV21"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV6-IGKV22"),]frequency) + 0.0000001), IGHV7 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV1"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV2"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV3"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV4"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV5"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV6"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV7"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV8"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV9"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV10"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV12"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV13"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV14"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV15"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV16"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV17"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV18"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV19"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV20"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV21"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV7-IGKV22"),]frequency)+0.0000001), IGHV8 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV1"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV2"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV3"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV4"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV5"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV6"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV7"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV8"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV9"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV10"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV12"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV13"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV14"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV15"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV16"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV17"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV18"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV19"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV20"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV21"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV8-IGKV22"),]frequency)+0.0000001), IGHV9 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV1"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV2"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV3"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV4"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV5"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV6"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV7"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV8"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV9"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV10"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV12"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV13"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV14"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV15"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV16"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV17"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV18"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV19"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV20"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV21"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV9-IGKV22"),]frequency) + 0.0000001), IGHV10 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV1"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV2"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV3"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV4"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV5"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV6"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV7"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV8"),]frequency)+0.0000001, sum(my_data[my_data$vj \%in\% c("IGHV10-IGKV9"),]frequency)+$

$0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV10”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV12”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV13”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV14”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV15”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV16”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV17”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV18”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV19”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV20”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV21”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV10-IGKV22”}),]frequency) + 0.0000001), IGHV11 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV1”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV2”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV3”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV4”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV5”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV6”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV7”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV8”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV9”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV10”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV12”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV13”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV14”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV15”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV16”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV17”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV18”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV19”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV20”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV21”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV11-IGKV22”}),]frequency) + 0.0000001), IGHV12 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV1”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV2”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV3”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV4”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV5”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV6”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV7”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV8”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV9”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV10”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV12”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV13”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV14”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV15”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV16”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV17”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV18”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV19”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV20”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV21”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV12-IGKV22”}),]frequency) + 0.0000001), IGHV15 = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV1”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV2”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV115-IGKV3”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV4”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV5”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV6”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV7”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV8”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV9”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV10”}),]frequency)+ 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV12”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV115-IGKV13”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV14”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV15”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV16”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV17”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV18”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV19”}),]frequency) + 0.0000001, sum(my_data[my_data\text{avj} \%in\% c(\text{“IGHV15-IGKV20”}),]frequency)+0.0000001, sum(my_data[my_data\text{avj}$

%in% c("IGHV15-IGKV21"),]$frequency) + 0.0000001, sum(my_data[my_data$vj %in% c("IGHV15-IGKV22"),]$frequency)+0.0000001), IGKV1= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV2= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV3= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1, IGKV4= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV5= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1, IGKV6= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV7= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1, IGKV8= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV9= c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1, IGKV10=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV12=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 IGKV13=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV14=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 IGKV15=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV16=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 IGKV17=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV18=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 IGKV19=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV20=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1 IGKV21=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1), IGKV22=c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1

```
r = c(255, 255, 255, 218, 220, 139, 123, 106, 0,  0,  0,  25, 0,  255, 240, 255, 255, 218, 
g = c(182, 105,  20, 112, 20,  0,   104, 90,  0,  0,  0,  25, 0,  250, 230, 255, 215, 165, 
b = c(193, 180, 147, 214, 60,  139, 238, 205, 255,255,139,112,128,205, 140, 0,   0,   32,  
stringsAsFactors = FALSE)
```

df1 <- m[, c(1,2, 37:39)] #modifiesd m <- m[,-(1:2)]/1e04 m <- as.matrix(m[,c(1:34)]) #modified dimnames(m) <- list(orig = df1$country, dest = df1$country)

df1 <- arrange(df1, order) df1$country <- factor(df1$country, levels = df1$country) m <- m[levels(df1$country),levels(df1$cou

df1$xmin <- 0 df1$xmax <- rowSums(m) + colSums(m) n <- nrow(df1) df1$rcol <- rgb(df1$r, df1$g, df1$b, max = 255) df1$lcol <- rgb(df1$r, df1$g, df1$b, alpha=200, max = 255)

par(mar=rep(0,4)) circos.clear()

circos.par(cell.padding=c(0,0,0,0), track.margin=c(0,0.15), start.degree = 90, gap.degree =4)

circos.initialize(factors = df1$country, xlim = cbind(df1$xmin, df1$xmax))

circos.trackPlotRegion(ylim = c(0, 1), factors = df1$country, track.height=0.1, #panel.fun for each sector panel.fun = function(x, y) { #select details of current sector name = get.cell.meta.data("sector.index") i = get.cell.meta.data("sector.numeric.index") xlim = get.cell.meta.data("xlim") ylim = get.cell.meta.data("ylim")

```
#text direction (dd) and adjusmtents (aa)
theta = circlize(mean(xlim), 1.3)[1, 1] %% 360
dd <- ifelse(theta < 90 || theta > 270, "clockwise", "reverse.clockwise")
aa = c(1, 0.5)
if(theta < 90 || theta > 270)  aa = c(0, 0.5)

#plot country labels
circos.text(x=mean(xlim), y=1.7, labels=name, facing = dd, cex=0.6,  adj = aa)

#plot main sector
circos.rect(xleft=xlim[1], ybottom=ylim[1], xright=xlim[2], ytop=ylim[2],
            col = df1$rcol[i], border=df1$rcol[i])

#blank in part of main sector
circos.rect(xleft=xlim[1], ybottom=ylim[1], xright=xlim[2]-rowSums(m)[i], ytop=ylim
            col = "white", border = "white")

#white line all the way around
circos.rect(xleft=xlim[1], ybottom=0.3, xright=xlim[2], ytop=0.32, col = "white", 
```

```
  #plot axis
  circos.axis(labels.cex=0.6, direction = "outside", major.at=seq(from=0,to=floor(df
              minor.ticks=1, labels.away.percentage = 0.15)
})
```

df1$sum1 < -colSums(m)df1sum2 <- numeric(n)

df2 <- cbind(as.data.frame(m),orig=rownames(m), stringsAsFactors=FALSE) df2 <- reshape(df2, idvar="orig", varying=list(1:n), direction="long", timevar="dest", time=rownames(m), v.names = "m") df2 <- arrange(df2,desc(m))

df2 <- subset(df2, m > quantile(m,0.6))

for(k in 1:nrow(df2)){ #i,j reference of flow matrix i<-match(df2$orig[k], df1country) j<-match(df2$dest[k], df1country)

#plot link circos.link(sector.index1=df1$country[i], point1 = c(df1sum1[i], df1$sum1[i]+abs(m[i, j])), sector.index2 = df1country[j], point2=c(df1$sum2[j], df1sum2[j] + abs(m[i, j])), col = df1$lcol[i])

df1$sum1[i] = df1sum1[i] + abs(m[i, j]) df1$sum2[j] = df1sum2[j] + abs(m[i, j]) }

"'