R Notebook

Parametros:

Measure = G-mean
Columns = sampling, weight_space, underbagging, learner
Performance = holdout_measure
Filter keys = imba.rate
Filter values = 0.001

```
library("scmamp")
library(dplyr)
```

Tratamento dos dados

Carregando data set compilado

```
ds = read.csv("/home/rodrigo/Dropbox/UNICAMP/IC/estudo_cost_learning/SummaryResults/summary_compilation_

ds = filter(ds, learner != "classif.rusboost")
summary(ds)
```

```
##                  learner      weight_space
##  classif.ksvm        :17100   Mode :logical
##  classif.randomForest:17100   FALSE:41040
##  classif.rusboost    :    0   TRUE :10260
##  classif.xgboost     :17100   NA's :0
##
##
##
##                             measure        sampling     underbagging
##  Accuracy                       :10260   ADASYN:10260   Mode :logical
##  Area under the curve           :10260   FALSE :30780   FALSE:41040
##  F1 measure                     :10260   SMOTE :10260   TRUE :10260
##  G-mean                         :10260                  NA's :0
##  Matthews correlation coefficient:10260
##
##
##  tuning_measure    holdout_measure   holdout_measure_residual
##  Min.   :-0.1277   Min.   :-0.2120   Min.   :-0.4658
##  1st Qu.: 0.6911   1st Qu.: 0.4001   1st Qu.: 0.1994
##  Median : 0.9700   Median : 0.8571   Median : 0.5581
##  Mean   : 0.7903   Mean   : 0.6718   Mean   : 0.5298
##  3rd Qu.: 0.9975   3rd Qu.: 0.9900   3rd Qu.: 0.8755
##  Max.   : 1.0000   Max.   : 1.0000   Max.   : 1.0000
##  NA's   :1077      NA's   :1077      NA's   :1077
##  iteration_count                      dataset        imba.rate
##  Min.   :1       abalone                 :  900   Min.   :0.0010
##  1st Qu.:1       adult                   :  900   1st Qu.:0.0100
##  Median :2       bank                    :  900   Median :0.0300
##  Mean   :2       car                     :  900   Mean   :0.0286
```

```
##  3rd Qu.:3       cardiotocography-10clases:  900   3rd Qu.:0.0500
##  Max.   :3       cardiotocography-3clases :  900   Max.   :0.0500
##  NA's   :1077    (Other)                  :45900
```

Filtrando pela metrica

```
ds = filter(ds, measure == params$measure)
```

Filtrando o data set

```
if(params$filter_keys != 'NULL' && !is.null(params$filter_keys)){
  dots = paste0(params$filter_keys," == '",params$filter_values,"'")
  ds = filter_(ds, .dots = dots)
}

summary(ds)
```

```
##                  learner    weight_space
##  classif.ksvm        :600   Mode :logical
##  classif.randomForest:600   FALSE:1440
##  classif.rusboost    :  0   TRUE :360
##  classif.xgboost     :600   NA's :0
##
##
##
##                              measure       sampling    underbagging
##  Accuracy                        :   0   ADASYN: 360   Mode :logical
##  Area under the curve            :   0   FALSE :1080   FALSE:1440
##  F1 measure                      :   0   SMOTE : 360   TRUE :360
##  G-mean                          :1800                 NA's :0
##  Matthews correlation coefficient:   0
##
##
##  tuning_measure   holdout_measure  holdout_measure_residual
##  Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.5941   1st Qu.:0.0000   1st Qu.:0.1173
##  Median :0.9638   Median :0.7062   Median :0.4257
##  Mean   :0.7528   Mean   :0.5598   Mean   :0.4404
##  3rd Qu.:0.9988   3rd Qu.:0.9645   3rd Qu.:0.7589
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
##  NA's   :48       NA's   :48       NA's   :48
##  iteration_count                      dataset       imba.rate
##  Min.   :1       abalone                  :  45   Min.   :0.001
##  1st Qu.:1       adult                    :  45   1st Qu.:0.001
##  Median :2       bank                     :  45   Median :0.001
##  Mean   :2       car                      :  45   Mean   :0.001
##  3rd Qu.:3       cardiotocography-10clases:  45   3rd Qu.:0.001
##  Max.   :3       cardiotocography-3clases :  45   Max.   :0.001
##  NA's   :48      (Other)                  :1530
```

Computando as médias das iteracoes

```
ds = group_by(ds, learner , weight_space , measure , sampling , underbagging , dataset , imba.rate)
ds = summarise(ds, tuning_measure = mean(tuning_measure), holdout_measure = mean(holdout_measure),
               holdout_measure_residual = mean(holdout_measure_residual))

ds = as.data.frame(ds)
```

Criando dataframe

```
# Dividindo o ds em n, um para cada técnica
splited_df = ds %>% group_by_at(.vars = params$columns) %>% do(vals = as.data.frame(.)) %>% select(vals)

# Juntando cada uma das partes horizontalmente em um data set
df_tec_wide = do.call("cbind", splited_df)

# Renomeando duplicacao de nomes
colnames(df_tec_wide) = make.unique(colnames(df_tec_wide))

# Selecionando apenas as medidas da performance escolhida
df_tec_wide_residual = select(df_tec_wide, matches(paste("^", params$performance, "$|", params$performa

# Renomeando colunas
new_names = NULL
for(i in (1:length(splited_df))){
  id = toString(sapply(splited_df[[i]][1, params$columns], as.character))
  new_names = c(new_names, id)
}
colnames(df_tec_wide_residual) = new_names

# Verificando a dimensao do df
dim(df_tec_wide_residual)
```

```
## [1] 40 15
```

```
# Renomeando a variavel
df = df_tec_wide_residual

head(df)
```

```
##   ADASYN, FALSE, FALSE, classif.ksvm
## 1                          0.0000000
## 2                          0.0000000
## 3                          0.0000000
## 4                          0.4646156
## 5                          0.0000000
## 6                          0.1924501
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.0000000
## 2                                  0.2505456
## 3                                  0.0000000
## 4                                  1.0000000
## 5                                  0.6372650
## 6                                  0.9388322
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                             0.0000000                          0.00000000
## 2                             0.4236795                          0.08202566
## 3                             0.0000000                          0.00000000
## 4                             0.9994722                          0.85911676
## 5                             0.7880998                          0.63807119
## 6                             0.9370562                          0.73678114
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.0000000
## 2                                 0.5396421
```

```
## 3                                0.0000000
## 4                                1.0000000
## 5                                0.3333333
## 6                                0.9995564
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.0000000                         0.5587283
## 2                           0.4769822                         0.6875628
## 3                           0.0000000                         0.6598937
## 4                           1.0000000                         1.0000000
## 5                           0.4997894                         0.7960663
## 6                           0.9991129                         0.9366085
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                               0.6129433
## 2                               0.8247649
## 3                               0.8307118
## 4                               0.9931144
## 5                               0.9476091
## 6                               0.9955549
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.6692660                         0.00000000
## 2                           0.8515676                         0.06713144
## 3                           0.8557636                         0.00000000
## 4                           0.9791795                         0.85911676
## 5                           0.8936202                         0.63807119
## 6                           0.9847078                         0.73678114
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                               0.0000000
## 2                               0.4726400
## 3                               0.0000000
## 4                               1.0000000
## 5                               0.5000000
## 6                               0.9995564
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.0000000                          0.0000000
## 2                           0.5147004                          0.1144564
## 3                           0.0000000                          0.0000000
## 4                           1.0000000                          0.6054989
## 5                           0.7440169                          0.1666667
## 6                           0.9991129                          0.1924501
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                               0.0000000
## 2                               0.2846110
## 3                               0.0000000
## 4                               1.0000000
## 5                               0.5686145
## 6                               0.9388322
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                           0.0000000
## 2                           0.4189175
## 3                           0.0000000
## 4                           1.0000000
## 5                           0.6905357
## 6                           0.9379451
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :0.0000
##  Mean   :0.2053
##  3rd Qu.:0.3701
##  Max.   :0.9459
##  NA's   :2
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.2025
##  Median :0.6378
##  Mean   :0.5638
##  3rd Qu.:0.9388
##  Max.   :1.0000
##  NA's   :6
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000                        Min.   :0.0000
##  1st Qu.:0.4675                        1st Qu.:0.0000
##  Median :0.7966                        Median :0.2452
##  Mean   :0.6912                        Mean   :0.3649
##  3rd Qu.:0.9739                        3rd Qu.:0.6842
##  Max.   :1.0000                        Max.   :1.0000
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :0.6172
##  Mean   :0.5386
##  3rd Qu.:0.9661
##  Max.   :1.0000
##  NA's   :2
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.0000                       Min.   :0.2753
##  1st Qu.:0.1336                       1st Qu.:0.6106
##  Median :0.6388                       Median :0.7672
##  Mean   :0.5514                       Mean   :0.7327
##  3rd Qu.:0.9446                       3rd Qu.:0.9024
##  Max.   :1.0000                       Max.   :1.0000
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.5538
##  1st Qu.:0.8651
##  Median :0.9468
##  Mean   :0.8978
##  3rd Qu.:0.9869
##  Max.   :1.0000
##  NA's   :1
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.3532                      Min.   :0.0000
##  1st Qu.:0.8584                      1st Qu.:0.0000
##  Median :0.9099                      Median :0.1853
```

```
##  Mean   :0.8884                      Mean   :0.3610
##  3rd Qu.:0.9765                      3rd Qu.:0.6842
##  Max.   :1.0000                      Max.   :1.0000
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :0.5728
##  Mean   :0.5308
##  3rd Qu.:0.9343
##  Max.   :1.0000
##  NA's   :2
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.0000                      Min.   :0.0000
##  1st Qu.:0.1889                      1st Qu.:0.0000
##  Median :0.7089                      Median :0.1353
##  Mean   :0.5658                      Mean   :0.2352
##  3rd Qu.:0.9399                      3rd Qu.:0.4799
##  Max.   :1.0000                      Max.   :1.0000
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.0000
##  1st Qu.:0.2357
##  Median :0.6660
##  Mean   :0.5870
##  3rd Qu.:0.9388
##  Max.   :1.0000
##  NA's   :3
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.0000
##  1st Qu.:0.5381
##  Median :0.7757
##  Mean   :0.6739
##  3rd Qu.:0.9756
##  Max.   :1.0000
##
```

Verificando a média de cada coluna selecionada

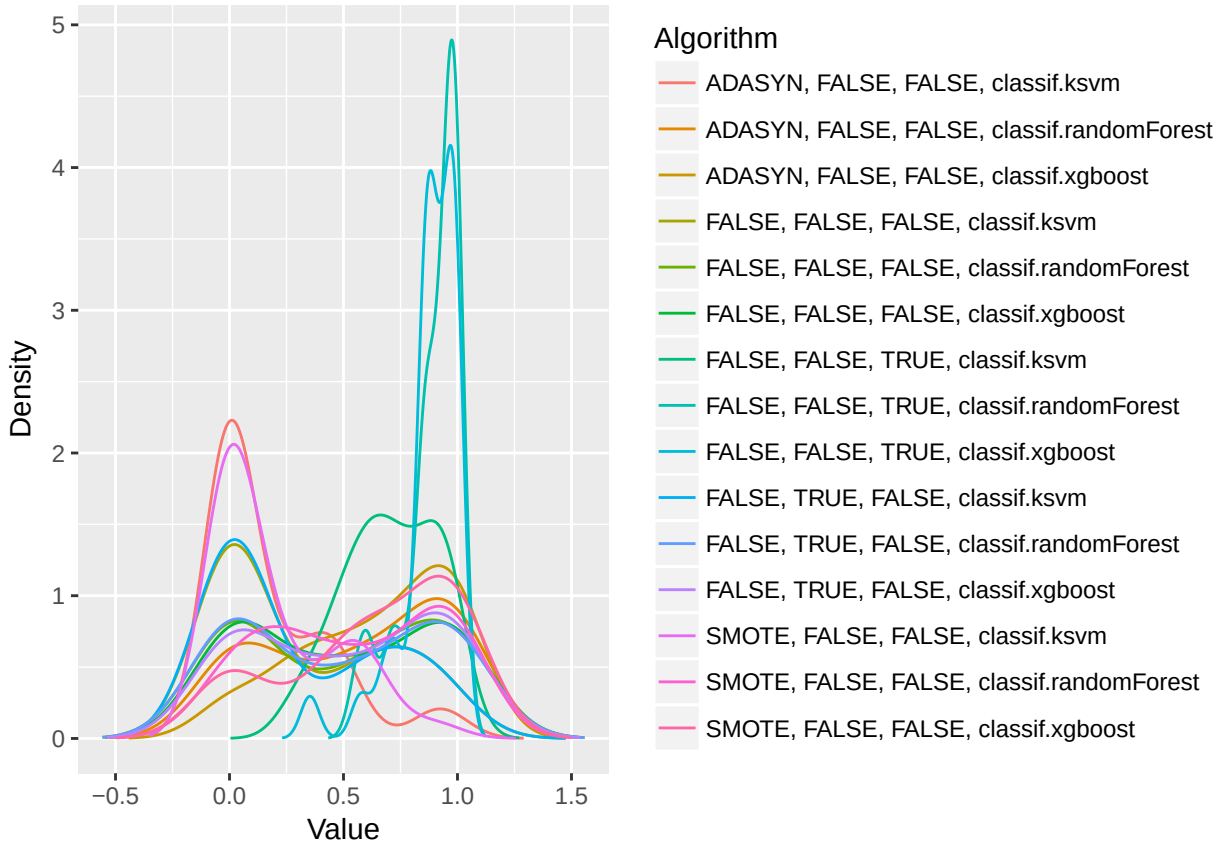
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.205303144031441"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.563751617351617"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.691204431259122"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.364947033827767"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.538559374619375"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.551373055070062"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.732730227110866"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.897754153513093"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.888413748602069"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.361043106852639"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.530751515931841"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.565815486002984"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.235150346934879"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.586987595079719"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.673937553992975"
```

Fazendo teste de normalidade

```
plotDensities(data = na.omit(df))
```



Testando as diferencas

```
friedmanTest(df)
```

```
##
##  Friedman's rank sum test
##
## data:  df
## Friedman's chi-squared = 220.61, df = 14, p-value < 2.2e-16
```

Testando as diferencas par a par

```
test <- nemenyiTest (df, alpha=0.05)
abs(test$diff.matrix) > test$statistic
```

```
##       ADASYN, FALSE, FALSE, classif.ksvm
##  [1,]                              FALSE
##  [2,]                               TRUE
##  [3,]                               TRUE
##  [4,]                              FALSE
##  [5,]                              FALSE
##  [6,]                               TRUE
##  [7,]                               TRUE
##  [8,]                               TRUE
##  [9,]                               TRUE
## [10,]                              FALSE
## [11,]                               TRUE
## [12,]                               TRUE
## [13,]                              FALSE
## [14,]                               TRUE
## [15,]                               TRUE
##       ADASYN, FALSE, FALSE, classif.randomForest
##  [1,]                                       TRUE
##  [2,]                                      FALSE
##  [3,]                                      FALSE
##  [4,]                                      FALSE
##  [5,]                                      FALSE
##  [6,]                                      FALSE
##  [7,]                                      FALSE
##  [8,]                                       TRUE
##  [9,]                                       TRUE
## [10,]                                      FALSE
## [11,]                                      FALSE
## [12,]                                      FALSE
## [13,]                                       TRUE
## [14,]                                      FALSE
## [15,]                                      FALSE
##       ADASYN, FALSE, FALSE, classif.xgboost
##  [1,]                                  TRUE
##  [2,]                                 FALSE
##  [3,]                                 FALSE
##  [4,]                                  TRUE
##  [5,]                                 FALSE
##  [6,]                                 FALSE
##  [7,]                                 FALSE
##  [8,]                                 FALSE
##  [9,]                                 FALSE
## [10,]                                  TRUE
## [11,]                                 FALSE
## [12,]                                 FALSE
## [13,]                                  TRUE
## [14,]                                 FALSE
## [15,]                                 FALSE
```

```
##       FALSE, FALSE, FALSE, classif.ksvm
##  [1,]                              FALSE
##  [2,]                              FALSE
##  [3,]                               TRUE
##  [4,]                              FALSE
##  [5,]                              FALSE
##  [6,]                              FALSE
##  [7,]                               TRUE
##  [8,]                               TRUE
##  [9,]                               TRUE
## [10,]                              FALSE
## [11,]                              FALSE
## [12,]                              FALSE
## [13,]                              FALSE
## [14,]                              FALSE
## [15,]                               TRUE
##       FALSE, FALSE, FALSE, classif.randomForest
##  [1,]                                     FALSE
##  [2,]                                     FALSE
##  [3,]                                     FALSE
##  [4,]                                     FALSE
##  [5,]                                     FALSE
##  [6,]                                     FALSE
##  [7,]                                     FALSE
##  [8,]                                      TRUE
##  [9,]                                      TRUE
## [10,]                                     FALSE
## [11,]                                     FALSE
## [12,]                                     FALSE
## [13,]                                      TRUE
## [14,]                                     FALSE
## [15,]                                     FALSE
##       FALSE, FALSE, FALSE, classif.xgboost
##  [1,]                                 TRUE
##  [2,]                                FALSE
##  [3,]                                FALSE
##  [4,]                                FALSE
##  [5,]                                FALSE
##  [6,]                                FALSE
##  [7,]                                FALSE
##  [8,]                                 TRUE
##  [9,]                                 TRUE
## [10,]                                FALSE
## [11,]                                FALSE
## [12,]                                FALSE
## [13,]                                 TRUE
## [14,]                                FALSE
## [15,]                                FALSE
##       FALSE, FALSE, TRUE, classif.ksvm
##  [1,]                             TRUE
##  [2,]                            FALSE
##  [3,]                            FALSE
##  [4,]                             TRUE
##  [5,]                            FALSE
```

```
##  [6,]                            FALSE
##  [7,]                            FALSE
##  [8,]                            FALSE
##  [9,]                            FALSE
## [10,]                             TRUE
## [11,]                            FALSE
## [12,]                            FALSE
## [13,]                             TRUE
## [14,]                            FALSE
## [15,]                            FALSE
##       FALSE, FALSE, TRUE, classif.randomForest
##  [1,]                                     TRUE
##  [2,]                                     TRUE
##  [3,]                                    FALSE
##  [4,]                                     TRUE
##  [5,]                                     TRUE
##  [6,]                                     TRUE
##  [7,]                                    FALSE
##  [8,]                                    FALSE
##  [9,]                                    FALSE
## [10,]                                     TRUE
## [11,]                                     TRUE
## [12,]                                     TRUE
## [13,]                                     TRUE
## [14,]                                     TRUE
## [15,]                                    FALSE
##       FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  [1,]                                TRUE                              FALSE
##  [2,]                                TRUE                              FALSE
##  [3,]                               FALSE                               TRUE
##  [4,]                                TRUE                              FALSE
##  [5,]                                TRUE                              FALSE
##  [6,]                                TRUE                              FALSE
##  [7,]                               FALSE                               TRUE
##  [8,]                               FALSE                               TRUE
##  [9,]                               FALSE                               TRUE
## [10,]                                TRUE                              FALSE
## [11,]                                TRUE                              FALSE
## [12,]                                TRUE                              FALSE
## [13,]                                TRUE                              FALSE
## [14,]                                TRUE                              FALSE
## [15,]                               FALSE                               TRUE
##       FALSE, TRUE, FALSE, classif.randomForest
##  [1,]                                     TRUE
##  [2,]                                    FALSE
##  [3,]                                    FALSE
##  [4,]                                    FALSE
##  [5,]                                    FALSE
##  [6,]                                    FALSE
##  [7,]                                    FALSE
##  [8,]                                     TRUE
##  [9,]                                     TRUE
## [10,]                                    FALSE
## [11,]                                    FALSE
```

```
## [12,]                                    FALSE
## [13,]                                     TRUE
## [14,]                                    FALSE
## [15,]                                    FALSE
##       FALSE, TRUE, FALSE, classif.xgboost
##  [1,]                                   TRUE
##  [2,]                                  FALSE
##  [3,]                                  FALSE
##  [4,]                                  FALSE
##  [5,]                                  FALSE
##  [6,]                                  FALSE
##  [7,]                                  FALSE
##  [8,]                                   TRUE
##  [9,]                                   TRUE
## [10,]                                  FALSE
## [11,]                                  FALSE
## [12,]                                  FALSE
## [13,]                                   TRUE
## [14,]                                  FALSE
## [15,]                                  FALSE
##       SMOTE, FALSE, FALSE, classif.ksvm
##  [1,]                                FALSE
##  [2,]                                 TRUE
##  [3,]                                 TRUE
##  [4,]                                FALSE
##  [5,]                                 TRUE
##  [6,]                                 TRUE
##  [7,]                                 TRUE
##  [8,]                                 TRUE
##  [9,]                                 TRUE
## [10,]                                FALSE
## [11,]                                 TRUE
## [12,]                                 TRUE
## [13,]                                FALSE
## [14,]                                 TRUE
## [15,]                                 TRUE
##       SMOTE, FALSE, FALSE, classif.randomForest
##  [1,]                                      TRUE
##  [2,]                                     FALSE
##  [3,]                                     FALSE
##  [4,]                                     FALSE
##  [5,]                                     FALSE
##  [6,]                                     FALSE
##  [7,]                                     FALSE
##  [8,]                                      TRUE
##  [9,]                                      TRUE
## [10,]                                     FALSE
## [11,]                                     FALSE
## [12,]                                     FALSE
## [13,]                                      TRUE
## [14,]                                     FALSE
## [15,]                                     FALSE
##       SMOTE, FALSE, FALSE, classif.xgboost
##  [1,]                                   TRUE
```

```
##  [2,]                                  FALSE
##  [3,]                                  FALSE
##  [4,]                                   TRUE
##  [5,]                                  FALSE
##  [6,]                                  FALSE
##  [7,]                                  FALSE
##  [8,]                                  FALSE
##  [9,]                                  FALSE
## [10,]                                   TRUE
## [11,]                                  FALSE
## [12,]                                  FALSE
## [13,]                                   TRUE
## [14,]                                  FALSE
## [15,]                                  FALSE
```

Plotando os ranks

```
print(colMeans(rankMatrix(df)))
```

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                    12.2500
## ADASYN, FALSE, FALSE, classif.randomForest
##                                     8.2625
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                     5.5125
##          FALSE, FALSE, FALSE, classif.ksvm
##                                    10.7375
##  FALSE, FALSE, FALSE, classif.randomForest
##                                     8.8500
##       FALSE, FALSE, FALSE, classif.xgboost
##                                     8.0250
##           FALSE, FALSE, TRUE, classif.ksvm
##                                     5.9750
##   FALSE, FALSE, TRUE, classif.randomForest
##                                     3.4250
##        FALSE, FALSE, TRUE, classif.xgboost
##                                     3.4750
##           FALSE, TRUE, FALSE, classif.ksvm
##                                    10.7625
##   FALSE, TRUE, FALSE, classif.randomForest
##                                     8.6750
##        FALSE, TRUE, FALSE, classif.xgboost
##                                     7.8375
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                    12.3875
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                     8.0375
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                     5.7875
```

Plotando grafico de Critical Diference

```
result = tryCatch({
    plotCD(df, alpha=0.05, cex = 0.35)
}, error = function(e) {})
```