# R Notebook

## Parametros:

**Measure =** Area under the curve
**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           :1800   FALSE :1080   FALSE:1440
##  F1 measure                     :   0   SMOTE : 360   TRUE :360
##  G-mean                         :   0                 NA's :0
##  Matthews correlation coefficient:   0
##
##
##  tuning_measure   holdout_measure  holdout_measure_residual
##  Min.   :0.3866   Min.   :0.2139   Min.   :0.3092
##  1st Qu.:0.9553   1st Qu.:0.8921   1st Qu.:0.7377
##  Median :0.9993   Median :0.9916   Median :0.9069
##  Mean   :0.9502   Mean   :0.9126   Mean   :0.8460
##  3rd Qu.:1.0000   3rd Qu.:1.0000   3rd Qu.:0.9840
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
##  NA's   :42       NA's   :42       NA's   :42
##  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   :42      (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                          0.5908544
## 2                                 NA
## 3                          0.6696128
## 4                          1.0000000
## 5                          0.8696338
## 6                          1.0000000
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.6115523
## 2                                         NA
## 3                                  0.8433817
## 4                                  1.0000000
## 5                                  0.9885311
## 6                                  1.0000000
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                            0.5329723                           0.5048135
## 2                            0.8532475                           0.4916767
## 3                            0.7760417                           0.7340067
## 4                            1.0000000                           1.0000000
## 5                            0.9934764                           0.9558081
## 6                            1.0000000                           1.0000000
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.7033093
## 2                                 0.8886010
```

```
## 3                                0.8314657
## 4                                1.0000000
## 5                                0.9900042
## 6                                1.0000000
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.6906137                         0.5738869
## 2                           0.9002132                         0.8178913
## 3                           0.9024358                         0.7362952
## 4                           1.0000000                         1.0000000
## 5                           0.9619108                         0.8627946
## 6                           1.0000000                         0.9440012
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                                0.6041516
## 2                                0.9036622
## 3                                0.8363584
## 4                                1.0000000
## 5                                0.9835859
## 6                                1.0000000
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.6801444                         0.5037304
## 2                           0.9019359                         0.5547681
## 3                           0.8885732                         0.7340067
## 4                           0.9992968                         1.0000000
## 5                           0.9436027                         0.9558081
## 6                           0.9943853                         1.0000000
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                                0.6951264
## 2                                       NA
## 3                                0.8935448
## 4                                1.0000000
## 5                                0.9800084
## 6                                1.0000000
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.6904934                         0.5335740
## 2                           0.8966787                         0.6074513
## 3                           0.9065920                         0.7012837
## 4                           1.0000000                         1.0000000
## 5                           0.9587542                         0.9156145
## 6                           1.0000000                         1.0000000
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                                0.6535499
## 2                                0.8881366
## 3                                0.8974905
## 4                                1.0000000
## 5                                0.9903199
## 6                                1.0000000
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                           0.5206980
## 2                           0.8799975
## 3                           0.7599432
## 4                           1.0000000
## 5                           0.9903199
## 6                           0.9997045
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.5048
##  1st Qu.:0.7857
##  Median :0.8908
##  Mean   :0.8522
##  3rd Qu.:0.9986
##  Max.   :1.0000
##  NA's   :3
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.5676
##  1st Qu.:0.9372
##  Median :0.9819
##  Mean   :0.9367
##  3rd Qu.:0.9999
##  Max.   :1.0000
##  NA's   :6
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.5330                        Min.   :0.4917
##  1st Qu.:0.9130                        1st Qu.:0.7393
##  Median :0.9914                        Median :0.9524
##  Mean   :0.9331                        Mean   :0.8654
##  3rd Qu.:0.9997                        3rd Qu.:0.9992
##  Max.   :1.0000                        Max.   :1.0000
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.5522
##  1st Qu.:0.9352
##  Median :0.9922
##  Mean   :0.9406
##  3rd Qu.:1.0000
##  Max.   :1.0000
##
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.6906                       Min.   :0.5739
##  1st Qu.:0.9279                       1st Qu.:0.8113
##  Median :0.9933                       Median :0.8733
##  Mean   :0.9507                       Mean   :0.8567
##  3rd Qu.:0.9998                       3rd Qu.:0.9466
##  Max.   :1.0000                       Max.   :1.0000
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.5529
##  1st Qu.:0.9184
##  Median :0.9901
##  Mean   :0.9339
##  3rd Qu.:0.9981
##  Max.   :1.0000
##
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.5882                      Min.   :0.5037
##  1st Qu.:0.9197                      1st Qu.:0.7393
##  Median :0.9815                      Median :0.9524
```

```
##  Mean   :0.9349                      Mean   :0.8663
##  3rd Qu.:0.9974                      3rd Qu.:0.9992
##  Max.   :1.0000                      Max.   :1.0000
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.6774
##  1st Qu.:0.9456
##  Median :0.9972
##  Mean   :0.9492
##  3rd Qu.:1.0000
##  Max.   :1.0000
##  NA's   :3
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.6905                      Min.   :0.5026
##  1st Qu.:0.9055                      1st Qu.:0.7289
##  Median :0.9894                      Median :0.9171
##  Mean   :0.9485                      Mean   :0.8471
##  3rd Qu.:0.9998                      3rd Qu.:0.9982
##  Max.   :1.0000                      Max.   :1.0000
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.6535
##  1st Qu.:0.9132
##  Median :0.9923
##  Mean   :0.9441
##  3rd Qu.:1.0000
##  Max.   :1.0000
##  NA's   :2
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.4858
##  1st Qu.:0.9437
##  Median :0.9903
##  Mean   :0.9327
##  3rd Qu.:0.9997
##  Max.   :1.0000
##
```

## Verificando a média de cada coluna selecionada

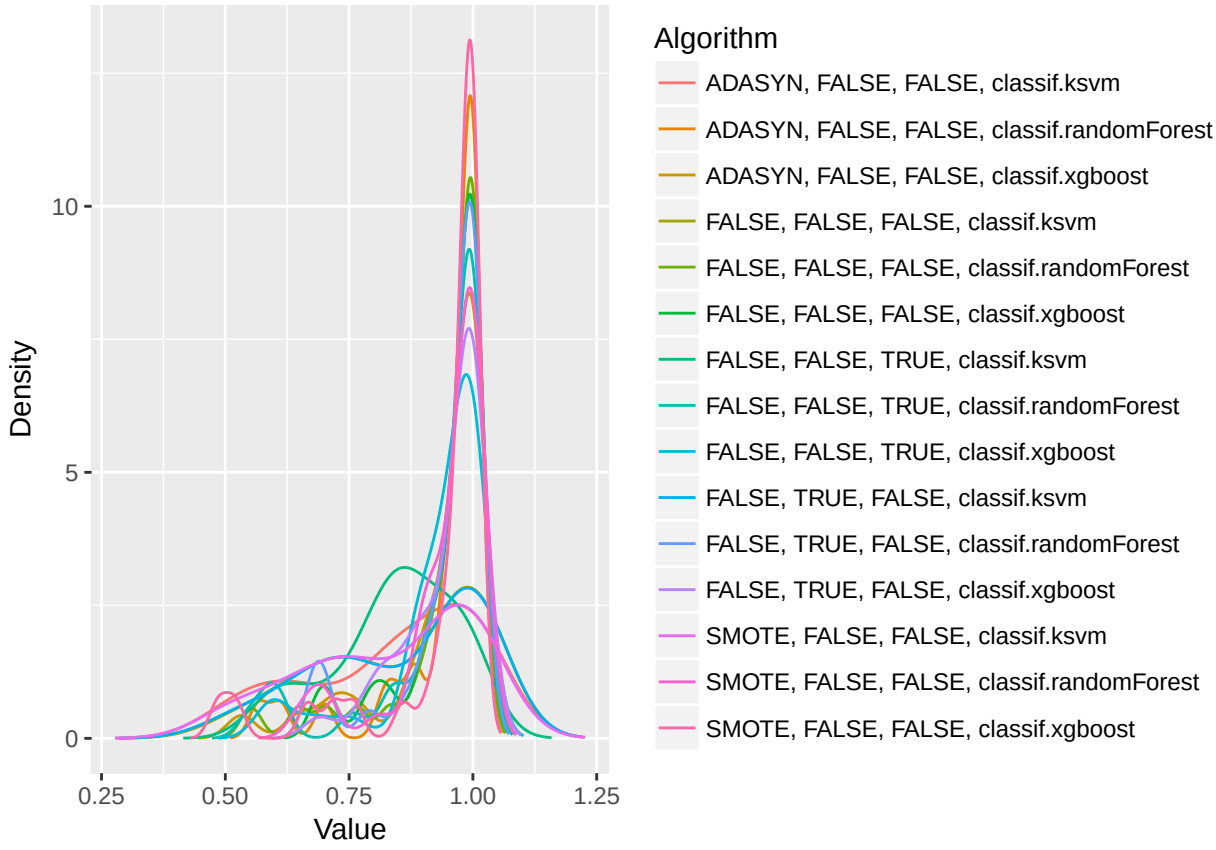
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.852232642605234"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.936736964977866"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.933114321485676"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.865384158603188"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.940622862694231"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.950695748958464"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.856662254538743"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.933857025289794"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.934894712184892"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.866264862403333"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.949167187229663"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.948533061331522"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.847050605409089"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.944059501288154"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.932740026711086"
```

## 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 = 98.168, df = 14, p-value = 1.066e-14
```

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

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

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

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

## Plotando os ranks

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

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                    10.4625
## ADASYN, FALSE, FALSE, classif.randomForest
##                                     7.2000
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                     7.4125
##          FALSE, FALSE, FALSE, classif.ksvm
##                                     9.0750
##  FALSE, FALSE, FALSE, classif.randomForest
##                                     5.9625
##       FALSE, FALSE, FALSE, classif.xgboost
##                                     5.6375
##           FALSE, FALSE, TRUE, classif.ksvm
##                                    11.6500
##   FALSE, FALSE, TRUE, classif.randomForest
##                                     7.9000
##        FALSE, FALSE, TRUE, classif.xgboost
##                                     8.7250
##           FALSE, TRUE, FALSE, classif.ksvm
##                                     9.2000
##   FALSE, TRUE, FALSE, classif.randomForest
##                                     6.3000
##        FALSE, TRUE, FALSE, classif.xgboost
##                                     6.2375
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                    10.6375
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                     6.7125
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                     6.8875
```

# Plotando grafico de Critical Diference

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