R Notebook

Parametros:

Measure = Matthews correlation coefficient
Columns = sampling, weight_space, underbagging, learner
Performance = holdout_measure
Filter keys = imba.rate
Filter values = 0.01

```
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                          :   0                 NA's :0
##  Matthews correlation coefficient:1800
##
##
##  tuning_measure     holdout_measure   holdout_measure_residual
##  Min.   :-0.00646   Min.   :-0.1370   Min.   :-0.06817
##  1st Qu.: 0.23261   1st Qu.: 0.0000   1st Qu.: 0.02011
##  Median : 0.82014   Median : 0.3764   Median : 0.19200
##  Mean   : 0.64070   Mean   : 0.4285   Mean   : 0.29498
##  3rd Qu.: 0.99730   3rd Qu.: 0.8152   3rd Qu.: 0.49996
##  Max.   : 1.00000   Max.   : 1.0000   Max.   : 1.00000
##  NA's   :69         NA's   :69        NA's   :69
##  iteration_count                      dataset       imba.rate
##  Min.   :1       abalone                  :  45   Min.   :0.01
##  1st Qu.:1       adult                    :  45   1st Qu.:0.01
##  Median :2       bank                     :  45   Median :0.01
##  Mean   :2       car                      :  45   Mean   :0.01
##  3rd Qu.:3       cardiotocography-10clases:  45   3rd Qu.:0.01
##  Max.   :3       cardiotocography-3clases :  45   Max.   :0.01
##  NA's   :69      (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                       -0.014499516
## 2                       -0.009081137
## 3                       -0.004917732
## 4                        0.463579851
## 5                        0.000000000
## 6                        0.191940287
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                -0.01440011
## 2                                 0.07535114
## 3                                -0.00286235
## 4                                 1.00000000
## 5                                 0.49884085
## 6                                 0.93847099
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                          -0.010554999                       -0.002681154
## 2                           0.242989502                        0.011520780
## 3                          -0.009202388                        0.000000000
## 4                           0.954884675                        0.858510613
## 5                           0.600634775                        0.636257514
## 6                           0.794855403                        0.735548937
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.0000000
## 2                                        NA
```

```
## 3                                0.0000000
## 4                                1.0000000
## 5                                0.3320778
## 6                                0.9549577
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                           0.0000000                       0.03648651
## 2                           0.4492768                       0.11251890
## 3                           0.0000000                       0.09881969
## 4                           1.0000000                       1.00000000
## 5                           0.4484451                       0.00000000
## 6                           0.9099153                       0.46374461
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                              0.05301455
## 2                              0.14841422
## 3                              0.17269359
## 4                              0.68133508
## 5                              0.28555458
## 6                              0.70932540
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                          0.07848644                      -0.004028968
## 2                          0.16753202                       0.009851304
## 3                          0.17800632                       0.000000000
## 4                          0.30122692                       0.858510613
## 5                          0.24506149                       0.636257514
## 6                          0.47403606                       0.735548937
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                              0.0000000
## 2                                     NA
## 3                              0.0000000
## 4                              1.0000000
## 5                              0.4981168
## 6                              0.9384710
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.0000000                       -0.015024224
## 2                           0.3699468                        0.012608807
## 3                           0.0000000                       -0.004539511
## 4                           1.0000000                        0.605069238
## 5                           0.6894596                        0.166038918
## 6                           0.9099153                        0.191940287
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                             -0.012556964
## 2                              0.112337728
## 3                             -0.004333984
## 4                              1.000000000
## 5                              0.467843754
## 6                              0.938470992
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                        -0.010790139
## 2                         0.266952337
## 3                        -0.008995889
## 4                         1.000000000
## 5                         0.401766327
## 6                         0.848386330
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :-0.0145
##  1st Qu.: 0.0000
##  Median : 0.0000
##  Mean   : 0.1914
##  3rd Qu.: 0.3232
##  Max.   : 0.9455
##  NA's   :2
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :-0.01440
##  1st Qu.: 0.08484
##  Median : 0.51921
##  Mean   : 0.49313
##  3rd Qu.: 0.93829
##  Max.   : 1.00000
##  NA's   :8
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :-0.01056                      Min.   :-0.004335
##  1st Qu.: 0.29845                      1st Qu.: 0.000000
##  Median : 0.64815                      Median : 0.225365
##  Mean   : 0.59152                      Mean   : 0.346678
##  3rd Qu.: 0.93094                      3rd Qu.: 0.683887
##  Max.   : 1.00000                      Max.   : 1.000000
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :-0.002375
##  1st Qu.: 0.000000
##  Median : 0.575532
##  Mean   : 0.514993
##  3rd Qu.: 0.947252
##  Max.   : 1.000000
##  NA's   :3
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :-0.005742                    Min.   :0.0000
##  1st Qu.: 0.170088                    1st Qu.:0.1001
##  Median : 0.612517                    Median :0.1741
##  Mean   : 0.538864                    Mean   :0.3527
##  3rd Qu.: 0.897964                    3rd Qu.:0.6027
##  Max.   : 1.000000                    Max.   :1.0000
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.03794
##  1st Qu.:0.17086
##  Median :0.34330
##  Mean   :0.38209
##  3rd Qu.:0.52785
##  Max.   :1.00000
##  NA's   :1
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :-0.02588                    Min.   :-0.004029
##  1st Qu.: 0.17384                    1st Qu.: 0.000000
##  Median : 0.26571                    Median : 0.184706
```

```
##  Mean   : 0.32038                    Mean   : 0.344307
##  3rd Qu.: 0.39103                    3rd Qu.: 0.683887
##  Max.   : 1.00000                    Max.   : 1.000000
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :-0.003281
##  1st Qu.: 0.000000
##  Median : 0.539700
##  Mean   : 0.504573
##  3rd Qu.: 0.900044
##  Max.   : 1.000000
##  NA's   :4
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :-0.005032                   Min.   :-0.01502
##  1st Qu.: 0.159433                   1st Qu.: 0.00000
##  Median : 0.671363                   Median : 0.02320
##  Mean   : 0.537200                   Mean   : 0.23050
##  3rd Qu.: 0.881911                   3rd Qu.: 0.47869
##  Max.   : 1.000000                   Max.   : 1.00000
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :-0.01256
##  1st Qu.: 0.14964
##  Median : 0.46784
##  Mean   : 0.51610
##  3rd Qu.: 0.93233
##  Max.   : 1.00000
##  NA's   :5
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :-0.01672
##  1st Qu.: 0.28440
##  Median : 0.68064
##  Mean   : 0.58764
##  3rd Qu.: 0.92596
##  Max.   : 1.00000
##
```

Verificando a média de cada coluna selecionada

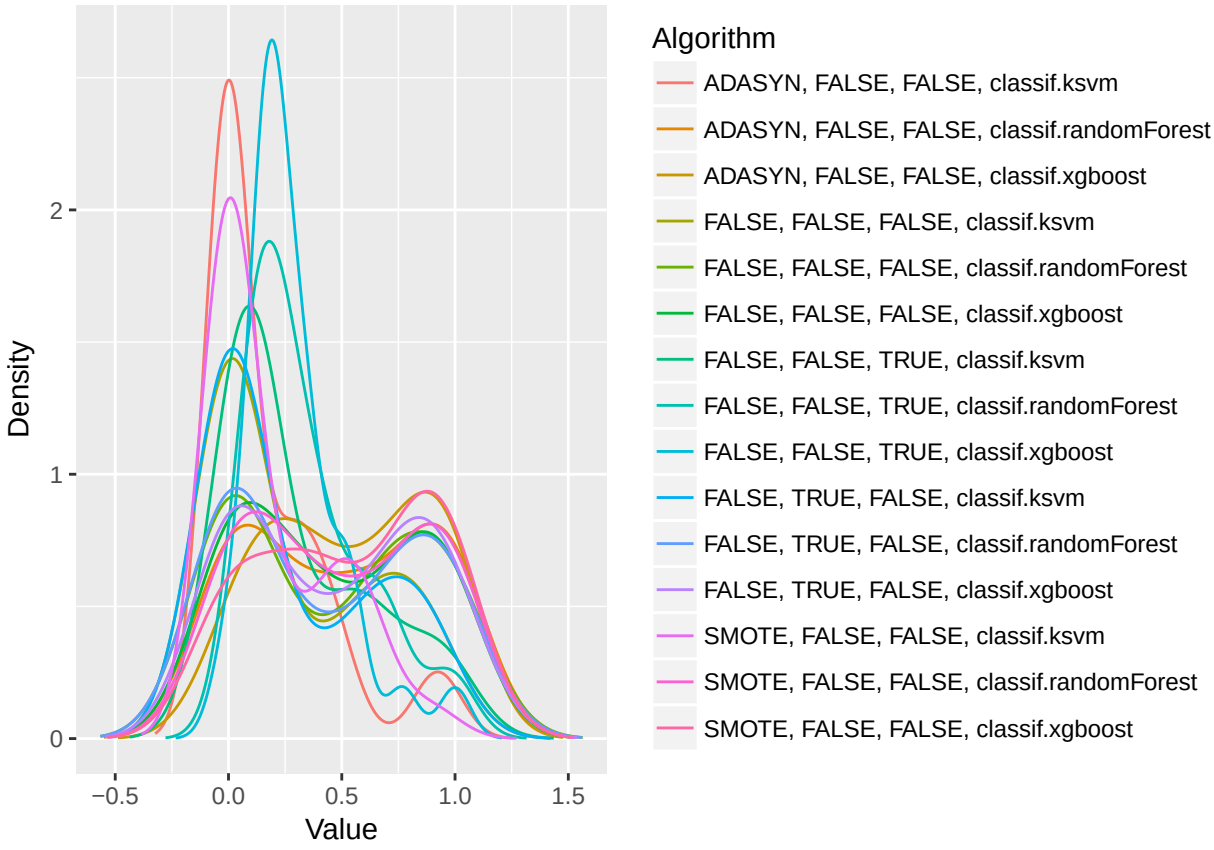
```
for(i in (1:dim(df)[2])){
  print(paste("Media da coluna ", colnames(df)[i], " = ", mean(df[,i], na.rm = TRUE), sep=""))
}
```

```
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.ksvm = 0.191372282616757"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.493127682404772"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.591522231454064"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.346677876313596"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.514992902345503"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.538864265752372"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.35266857312572"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.382087619655475"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.32038390509281"
```

```
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.344306687051818"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.504572782770068"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.53719997235341"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.230496923387896"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.516101364921322"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.587635154564366"
```

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 = 114.37, 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,]                               TRUE
##  [6,]                               TRUE
##  [7,]                              FALSE
##  [8,]                               TRUE
##  [9,]                              FALSE
## [10,]                              FALSE
## [11,]                               TRUE
## [12,]                               TRUE
## [13,]                              FALSE
## [14,]                               TRUE
## [15,]                               TRUE
##       ADASYN, FALSE, FALSE, classif.randomForest
##  [1,]                                       TRUE
##  [2,]                                      FALSE
##  [3,]                                       TRUE
##  [4,]                                      FALSE
##  [5,]                                      FALSE
##  [6,]                                      FALSE
##  [7,]                                      FALSE
##  [8,]                                      FALSE
##  [9,]                                      FALSE
## [10,]                                      FALSE
## [11,]                                      FALSE
## [12,]                                      FALSE
## [13,]                                       TRUE
## [14,]                                      FALSE
## [15,]                                      FALSE
##       ADASYN, FALSE, FALSE, classif.xgboost
##  [1,]                                  TRUE
##  [2,]                                  TRUE
##  [3,]                                 FALSE
##  [4,]                                  TRUE
##  [5,]                                 FALSE
##  [6,]                                 FALSE
##  [7,]                                  TRUE
##  [8,]                                  TRUE
##  [9,]                                  TRUE
## [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,]                              FALSE
##  [8,]                              FALSE
##  [9,]                              FALSE
## [10,]                              FALSE
## [11,]                              FALSE
## [12,]                              FALSE
## [13,]                              FALSE
## [14,]                              FALSE
## [15,]                               TRUE
##       FALSE, FALSE, FALSE, classif.randomForest
##  [1,]                                      TRUE
##  [2,]                                     FALSE
##  [3,]                                     FALSE
##  [4,]                                     FALSE
##  [5,]                                     FALSE
##  [6,]                                     FALSE
##  [7,]                                     FALSE
##  [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,]                               FALSE
##  [5,]                               FALSE
##  [6,]                               FALSE
##  [7,]                               FALSE
##  [8,]                               FALSE
##  [9,]                               FALSE
## [10,]                               FALSE
## [11,]                               FALSE
## [12,]                               FALSE
## [13,]                                TRUE
## [14,]                               FALSE
## [15,]                               FALSE
##       FALSE, FALSE, TRUE, classif.ksvm
##  [1,]                             FALSE
##  [2,]                             FALSE
##  [3,]                              TRUE
##  [4,]                             FALSE
##  [5,]                             FALSE
```

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

Plotando os ranks

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

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                    11.6125
## ADASYN, FALSE, FALSE, classif.randomForest
##                                     8.1500
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                     4.6750
##          FALSE, FALSE, FALSE, classif.ksvm
##                                     9.4000
##  FALSE, FALSE, FALSE, classif.randomForest
##                                     7.3500
##       FALSE, FALSE, FALSE, classif.xgboost
##                                     6.1375
##           FALSE, FALSE, TRUE, classif.ksvm
##                                     8.4500
##   FALSE, FALSE, TRUE, classif.randomForest
##                                     8.2000
##        FALSE, FALSE, TRUE, classif.xgboost
##                                     8.7500
##           FALSE, TRUE, FALSE, classif.ksvm
##                                     9.3750
##   FALSE, TRUE, FALSE, classif.randomForest
##                                     7.6625
##        FALSE, TRUE, FALSE, classif.xgboost
##                                     6.1125
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                    11.5750
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                     7.3000
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                     5.2500
```

Plotando grafico de Critical Diference

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