R Notebook

Parametros:

Measure = Accuracy
Columns = sampling, weight_space, underbagging, learner
Performance = tuning_measure
Filter keys = imba.rate
Filter values = 0.03

```
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        :990   Mode :logical
##  classif.randomForest:990   FALSE:2376
##  classif.rusboost    :  0   TRUE :594
##  classif.xgboost     :990   NA's :0
##
##
##
##                               measure       sampling    underbagging
##  Accuracy                        :2970   ADASYN: 594   Mode :logical
##  Area under the curve            :   0   FALSE :1782   FALSE:2376
##  F1 measure                      :   0   SMOTE : 594   TRUE :594
##  G-mean                          :   0                 NA's :0
##  Matthews correlation coefficient:   0
##
##
##  tuning_measure    holdout_measure   holdout_measure_residual
##  Min.   :0.09041   Min.   :0.02655   Min.   :0.0346
##  1st Qu.:0.96926   1st Qu.:0.96647   1st Qu.:0.3599
##  Median :0.98130   Median :0.97619   Median :0.6882
##  Mean   :0.95405   Mean   :0.94750   Mean   :0.6478
##  3rd Qu.:0.99560   3rd Qu.:0.99045   3rd Qu.:0.9438
##  Max.   :1.00000   Max.   :1.00000   Max.   :1.0000
##  NA's   :57        NA's   :57        NA's   :57
##  iteration_count          dataset       imba.rate
##  Min.   :1       abalone      :  45   Min.   :0.03
##  1st Qu.:1       adult        :  45   1st Qu.:0.03
##  Median :2       annealing    :  45   Median :0.03
##  Mean   :2       arrhythmia   :  45   Mean   :0.03
##  3rd Qu.:3       balance-scale:  45   3rd Qu.:0.03
##  Max.   :3       bank         :  45   Max.   :0.03
##  NA's   :57      (Other)      :2700
```

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

```r
# 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] 66 15
```

```r
# Renomeando a variavel
df = df_tec_wide_residual

head(df)
```

```
##   ADASYN, FALSE, FALSE, classif.ksvm
## 1                          0.9595381
## 2                          0.9749599
## 3                          0.9831176
## 4                          0.9241574
## 5                          1.0000000
## 6                          0.9850835
##   ADASYN, FALSE, FALSE, classif.randomForest
## 1                                  0.9566567
## 2                                         NA
## 3                                  0.9926403
## 4                                  0.9970458
## 5                                  1.0000000
## 6                                         NA
##   ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
## 1                             0.9671889                         0.9578372
## 2                             0.9842633                         0.9663640
## 3                             0.9883465                         0.9691089
## 4                             0.9866841                         0.9684141
## 5                             1.0000000                         0.9975170
## 6                             0.9842693                         0.9699278
##   FALSE, FALSE, FALSE, classif.randomForest
## 1                                 0.9697619
## 2                                        NA
## 3                                 0.9798042
## 4                                 0.9779849
## 5                                 1.0000000
## 6                                 0.9695214
##   FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
## 1                            0.9697619                        0.6175442
## 2                            0.9775379                        0.9163519
## 3                            0.9750536                        0.9489037
## 4                            0.9760693                        0.8627718
## 5                            1.0000000                        0.9838255
## 6                            0.9693184                        0.5901602
##   FALSE, FALSE, TRUE, classif.randomForest
## 1                                0.5934099
## 2                                0.7957626
## 3                                0.8300747
## 4                                0.9061451
## 5                                0.9267302
## 6                                0.8092056
##   FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
## 1                           0.6314521                        0.9625227
## 2                           0.8091126                        0.9662495
## 3                           0.8145848                        0.9691089
## 4                           0.9214709                        0.9684141
## 5                           0.9240949                        0.9975170
## 6                           0.7991469                        0.9699278
##   FALSE, TRUE, FALSE, classif.randomForest
## 1                                0.9697619
## 2                                0.9769489
## 3                                0.9786156
## 4                                0.9808670
## 5                                1.0000000
## 6                                0.9697246
##   FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
## 1                           0.9699038                         0.9611646
## 2                           0.9772270                         0.9763133
## 3                           0.9738621                         0.9822298
## 4                           0.9751364                         0.8695467
## 5                           1.0000000                         1.0000000
## 6                           0.9693184                         0.9840940
##   SMOTE, FALSE, FALSE, classif.randomForest
## 1                                 0.9550077
## 2                                 0.9795664
## 3                                 0.9929624
## 4                                 0.9950040
## 5                                 1.0000000
## 6                                 0.9848819
##   SMOTE, FALSE, FALSE, classif.xgboost
## 1                            0.9676123
## 2                            0.9851323
## 3                            0.9880556
## 4                            0.9890114
## 5                            1.0000000
## 6                            0.9849344
```

```r
summary(df)
```

```
##  ADASYN, FALSE, FALSE, classif.ksvm
##  Min.   :0.7764
##  1st Qu.:0.9809
##  Median :0.9942
##  Mean   :0.9811
##  3rd Qu.:0.9977
##  Max.   :1.0000
##  NA's   :2
##  ADASYN, FALSE, FALSE, classif.randomForest
##  Min.   :0.7717
##  1st Qu.:0.9830
##  Median :0.9968
##  Mean   :0.9865
##  3rd Qu.:0.9993
##  Max.   :1.0000
##  NA's   :7
##  ADASYN, FALSE, FALSE, classif.xgboost FALSE, FALSE, FALSE, classif.ksvm
##  Min.   :0.7715                        Min.   :0.9569
##  1st Qu.:0.9826                        1st Qu.:0.9697
##  Median :0.9936                        Median :0.9706
##  Mean   :0.9853                        Mean   :0.9752
##  3rd Qu.:0.9983                        3rd Qu.:0.9810
##  Max.   :1.0000                        Max.   :0.9977
##
##  FALSE, FALSE, FALSE, classif.randomForest
##  Min.   :0.9680
##  1st Qu.:0.9705
##  Median :0.9802
##  Mean   :0.9822
##  3rd Qu.:0.9922
##  Max.   :1.0000
##  NA's   :2
##  FALSE, FALSE, FALSE, classif.xgboost FALSE, FALSE, TRUE, classif.ksvm
##  Min.   :0.9656                       Min.   :0.2896
##  1st Qu.:0.9737                       1st Qu.:0.6963
##  Median :0.9819                       Median :0.9189
##  Mean   :0.9833                       Mean   :0.8290
##  3rd Qu.:0.9930                       3rd Qu.:0.9775
##  Max.   :1.0000                       Max.   :0.9973
##
##  FALSE, FALSE, TRUE, classif.randomForest
##  Min.   :0.5074
##  1st Qu.:0.7763
##  Median :0.8945
##  Mean   :0.8529
##  3rd Qu.:0.9666
##  Max.   :1.0000
##  NA's   :2
##  FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  Min.   :0.4993                      Min.   :0.9617
##  1st Qu.:0.7990                      1st Qu.:0.9697
##  Median :0.8917                      Median :0.9705
##  Mean   :0.8463                      Mean   :0.9751
##  3rd Qu.:0.9540                      3rd Qu.:0.9810
##  Max.   :1.0000                      Max.   :0.9977
##
##  FALSE, TRUE, FALSE, classif.randomForest
##  Min.   :0.9677
##  1st Qu.:0.9705
##  Median :0.9798
##  Mean   :0.9823
##  3rd Qu.:0.9928
##  Max.   :1.0000
##  NA's   :1
##  FALSE, TRUE, FALSE, classif.xgboost SMOTE, FALSE, FALSE, classif.ksvm
##  Min.   :0.9656                      Min.   :0.7761
##  1st Qu.:0.9742                      1st Qu.:0.9769
##  Median :0.9818                      Median :0.9924
##  Mean   :0.9833                      Mean   :0.9808
##  3rd Qu.:0.9929                      3rd Qu.:0.9976
##  Max.   :1.0000                      Max.   :1.0000
##
##  SMOTE, FALSE, FALSE, classif.randomForest
##  Min.   :0.7750
##  1st Qu.:0.9819
##  Median :0.9954
##  Mean   :0.9865
##  3rd Qu.:0.9993
##  Max.   :1.0000
##  NA's   :5
##  SMOTE, FALSE, FALSE, classif.xgboost
##  Min.   :0.7750
##  1st Qu.:0.9822
##  Median :0.9941
##  Mean   :0.9860
##  3rd Qu.:0.9981
##  Max.   :1.0000
##
```

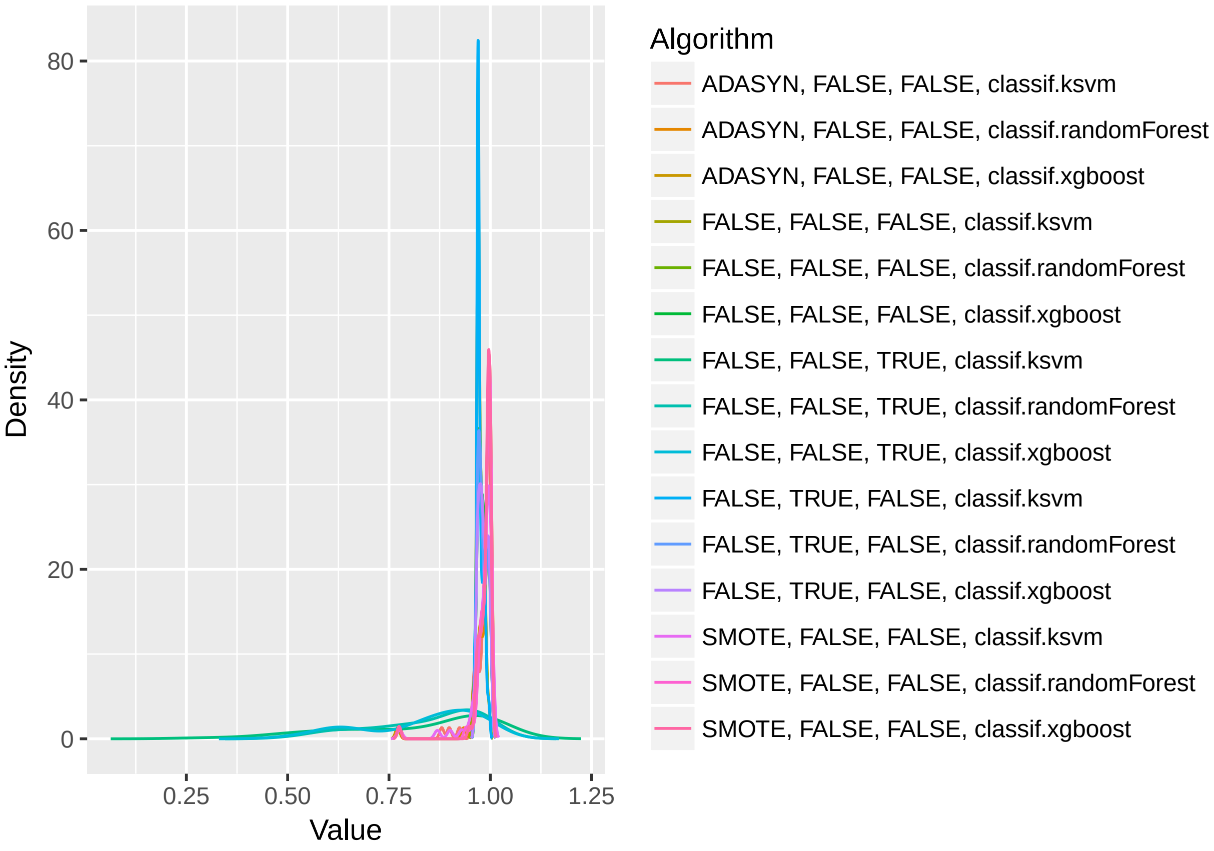
Verificando a média de cada coluna selecionada

```r
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 = 0.981089172328964"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.randomForest = 0.986507892933772"
## [1] "Media da coluna ADASYN, FALSE, FALSE, classif.xgboost = 0.985320119782326"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.ksvm = 0.975237303652973"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.randomForest = 0.982232504000285"
## [1] "Media da coluna FALSE, FALSE, FALSE, classif.xgboost = 0.983314101281034"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.ksvm = 0.828952284039238"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.randomForest = 0.852911103010748"
## [1] "Media da coluna FALSE, FALSE, TRUE, classif.xgboost = 0.846292309755586"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.ksvm = 0.975071996792856"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.randomForest = 0.982303264242282"
## [1] "Media da coluna FALSE, TRUE, FALSE, classif.xgboost = 0.983275975322345"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.ksvm = 0.980768143223078"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.randomForest = 0.986499616970574"
## [1] "Media da coluna SMOTE, FALSE, FALSE, classif.xgboost = 0.98596666289117"
```

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 = 499.08, 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,]                              FALSE
##  [3,]                              FALSE
##  [4,]                               TRUE
##  [5,]                              FALSE
##  [6,]                              FALSE
##  [7,]                               TRUE
##  [8,]                               TRUE
##  [9,]                               TRUE
## [10,]                               TRUE
## [11,]                              FALSE
## [12,]                              FALSE
## [13,]                              FALSE
## [14,]                              FALSE
## [15,]                              FALSE
##       ADASYN, FALSE, FALSE, classif.randomForest
##  [1,]                                      FALSE
##  [2,]                                      FALSE
##  [3,]                                      FALSE
##  [4,]                                       TRUE
##  [5,]                                       TRUE
##  [6,]                                      FALSE
##  [7,]                                       TRUE
##  [8,]                                       TRUE
##  [9,]                                       TRUE
## [10,]                                       TRUE
## [11,]                                       TRUE
## [12,]                                      FALSE
## [13,]                                      FALSE
## [14,]                                      FALSE
## [15,]                                      FALSE
##       ADASYN, FALSE, FALSE, classif.xgboost
##  [1,]                                 FALSE
##  [2,]                                 FALSE
##  [3,]                                 FALSE
##  [4,]                                  TRUE
##  [5,]                                  TRUE
##  [6,]                                 FALSE
##  [7,]                                  TRUE
##  [8,]                                  TRUE
##  [9,]                                  TRUE
## [10,]                                  TRUE
## [11,]                                  TRUE
## [12,]                                 FALSE
## [13,]                                 FALSE
## [14,]                                 FALSE
## [15,]                                 FALSE
##       FALSE, FALSE, FALSE, classif.ksvm
##  [1,]                              TRUE
##  [2,]                              TRUE
##  [3,]                              TRUE
##  [4,]                             FALSE
##  [5,]                             FALSE
##  [6,]                              TRUE
##  [7,]                              TRUE
##  [8,]                              TRUE
##  [9,]                              TRUE
## [10,]                             FALSE
## [11,]                             FALSE
## [12,]                              TRUE
## [13,]                              TRUE
## [14,]                              TRUE
## [15,]                              TRUE
##       FALSE, FALSE, FALSE, classif.randomForest
##  [1,]                                     FALSE
##  [2,]                                      TRUE
##  [3,]                                      TRUE
##  [4,]                                     FALSE
##  [5,]                                     FALSE
##  [6,]                                     FALSE
##  [7,]                                      TRUE
##  [8,]                                      TRUE
##  [9,]                                      TRUE
## [10,]                                     FALSE
## [11,]                                     FALSE
## [12,]                                     FALSE
## [13,]                                      TRUE
## [14,]                                      TRUE
## [15,]                                      TRUE
##       FALSE, FALSE, FALSE, classif.xgboost
##  [1,]                                FALSE
##  [2,]                                FALSE
##  [3,]                                FALSE
##  [4,]                                 TRUE
##  [5,]                                FALSE
##  [6,]                                FALSE
##  [7,]                                 TRUE
##  [8,]                                 TRUE
##  [9,]                                 TRUE
## [10,]                                 TRUE
## [11,]                                FALSE
## [12,]                                FALSE
## [13,]                                FALSE
## [14,]                                 TRUE
## [15,]                                FALSE
##       FALSE, FALSE, TRUE, classif.ksvm
##  [1,]                             TRUE
##  [2,]                             TRUE
##  [3,]                             TRUE
##  [4,]                             TRUE
##  [5,]                             TRUE
##  [6,]                             TRUE
##  [7,]                            FALSE
##  [8,]                            FALSE
##  [9,]                            FALSE
## [10,]                             TRUE
## [11,]                             TRUE
## [12,]                             TRUE
## [13,]                             TRUE
## [14,]                             TRUE
## [15,]                             TRUE
##       FALSE, FALSE, TRUE, classif.randomForest
##  [1,]                                     TRUE
##  [2,]                                     TRUE
##  [3,]                                     TRUE
##  [4,]                                     TRUE
##  [5,]                                     TRUE
##  [6,]                                     TRUE
##  [7,]                                    FALSE
##  [8,]                                    FALSE
##  [9,]                                    FALSE
## [10,]                                     TRUE
## [11,]                                     TRUE
## [12,]                                     TRUE
## [13,]                                     TRUE
## [14,]                                     TRUE
## [15,]                                     TRUE
##       FALSE, FALSE, TRUE, classif.xgboost FALSE, TRUE, FALSE, classif.ksvm
##  [1,]                                TRUE                             TRUE
##  [2,]                                TRUE                             TRUE
##  [3,]                                TRUE                             TRUE
##  [4,]                                TRUE                            FALSE
##  [5,]                                TRUE                            FALSE
##  [6,]                                TRUE                             TRUE
##  [7,]                               FALSE                             TRUE
##  [8,]                               FALSE                             TRUE
##  [9,]                               FALSE                             TRUE
## [10,]                                TRUE                            FALSE
## [11,]                                TRUE                            FALSE
## [12,]                                TRUE                             TRUE
## [13,]                                TRUE                             TRUE
## [14,]                                TRUE                             TRUE
## [15,]                                TRUE                             TRUE
##       FALSE, TRUE, FALSE, classif.randomForest
##  [1,]                                    FALSE
##  [2,]                                     TRUE
##  [3,]                                     TRUE
##  [4,]                                    FALSE
##  [5,]                                    FALSE
##  [6,]                                    FALSE
##  [7,]                                     TRUE
##  [8,]                                     TRUE
##  [9,]                                     TRUE
## [10,]                                    FALSE
## [11,]                                    FALSE
## [12,]                                    FALSE
## [13,]                                    FALSE
## [14,]                                     TRUE
## [15,]                                     TRUE
##         FALSE, TRUE, FALSE, classif.xgboost
##  [1,]                               FALSE
##  [2,]                               FALSE
##  [3,]                               FALSE
##  [4,]                                TRUE
##  [5,]                               FALSE
##  [6,]                               FALSE
##  [7,]                                TRUE
##  [8,]                                TRUE
##  [9,]                                TRUE
## [10,]                                TRUE
## [11,]                               FALSE
## [12,]                               FALSE
## [13,]                               FALSE
## [14,]                                TRUE
## [15,]                               FALSE
##         SMOTE, FALSE, FALSE, classif.ksvm
##  [1,]                             FALSE
##  [2,]                             FALSE
##  [3,]                             FALSE
##  [4,]                              TRUE
##  [5,]                              TRUE
##  [6,]                             FALSE
##  [7,]                              TRUE
##  [8,]                              TRUE
##  [9,]                              TRUE
## [10,]                              TRUE
## [11,]                             FALSE
## [12,]                             FALSE
## [13,]                             FALSE
## [14,]                             FALSE
## [15,]                             FALSE
##         SMOTE, FALSE, FALSE, classif.randomForest
##  [1,]                                     FALSE
##  [2,]                                     FALSE
##  [3,]                                     FALSE
##  [4,]                                      TRUE
##  [5,]                                      TRUE
##  [6,]                                      TRUE
##  [7,]                                      TRUE
##  [8,]                                      TRUE
##  [9,]                                      TRUE
## [10,]                                      TRUE
## [11,]                                      TRUE
## [12,]                                      TRUE
## [13,]                                     FALSE
## [14,]                                     FALSE
## [15,]                                     FALSE
##         SMOTE, FALSE, FALSE, classif.xgboost
##  [1,]                                FALSE
##  [2,]                                FALSE
##  [3,]                                FALSE
##  [4,]                                 TRUE
##  [5,]                                 TRUE
##  [6,]                                FALSE
##  [7,]                                 TRUE
##  [8,]                                 TRUE
##  [9,]                                 TRUE
## [10,]                                 TRUE
## [11,]                                 TRUE
## [12,]                                FALSE
## [13,]                                FALSE
## [14,]                                FALSE
## [15,]                                FALSE
```

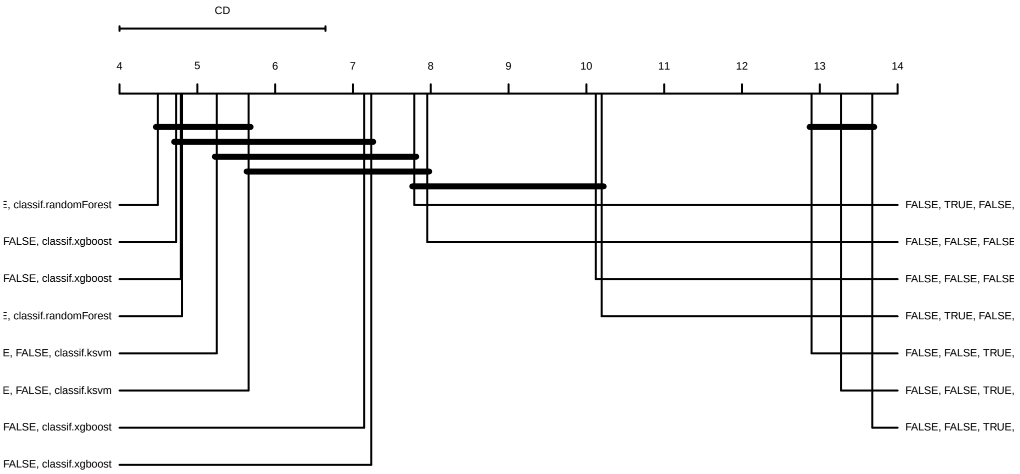
Plotando os ranks

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

```
##         ADASYN, FALSE, FALSE, classif.ksvm
##                                   5.659091
## ADASYN, FALSE, FALSE, classif.randomForest
##                                   4.803030
##      ADASYN, FALSE, FALSE, classif.xgboost
##                                   4.727273
##          FALSE, FALSE, FALSE, classif.ksvm
##                                  10.121212
##  FALSE, FALSE, FALSE, classif.randomForest
##                                   7.954545
##       FALSE, FALSE, FALSE, classif.xgboost
##                                   7.143939
##           FALSE, FALSE, TRUE, classif.ksvm
##                                  12.893939
##   FALSE, FALSE, TRUE, classif.randomForest
##                                  13.272727
##        FALSE, FALSE, TRUE, classif.xgboost
##                                  13.674242
##           FALSE, TRUE, FALSE, classif.ksvm
##                                  10.196970
##   FALSE, TRUE, FALSE, classif.randomForest
##                                   7.787879
##        FALSE, TRUE, FALSE, classif.xgboost
##                                   7.234848
##          SMOTE, FALSE, FALSE, classif.ksvm
##                                   5.250000
##  SMOTE, FALSE, FALSE, classif.randomForest
##                                   4.492424
##       SMOTE, FALSE, FALSE, classif.xgboost
##                                   4.787879
```

Plotando grafico de Critical Diference

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


CD
E, classif.randomForest
FALSE, classif.xgboost
FALSE, classif.xgboost
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