

Day 03 - Exercise 01 - Boosting Trees

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Preamble

The exercises here are taken from the `boosting-trees.R` file in the `scripts/day_03` directory.

In order to be able to run the code in here, you need to run the following:

```
## Installing packages
install.packages('rpart')
install.packages('mlbench')
install.packages('caret')
install.packages('gbm')

## Loading packages
library('rpart')
library('mlbench')
library('caret')
library('gbm')
```

These packages are needed in order to run some of the commands.

We can now **load** the necessary libraries:

```
library('rpart')
library('mlbench')
library('gbm')
```

```
## Loading required package: survival
##
## Attaching package: 'survival'
## The following object is masked from 'package:rpart':
##
##      solder
## Loading required package: lattice
## Loading required package: splines
## Loading required package: parallel
## Loaded gbm 2.1.3
library('caret')

## Loading required package: ggplot2
##
## Attaching package: 'caret'
## The following object is masked from 'package:survival':
##
##      cluster
```

Exercise 1

1. Use the 'cv.folds' option to 'gbm' to perform 10-fold cross-validation of the 'gbm' model for breast cancer above by varying 'n.trees'. Select an optimal 'n.trees' and compute the test error using the testing data.

```
# Defining dataset
data('BreastCancer')
BreastCancer$y <- ifelse(BreastCancer$Class == "malignant", 1, -1)
BreastCancer$Class <- NULL
BreastCancer$Id <- NULL
head(BreastCancer)
```

##	Cl.thickness	Cell.size	Cell.shape	Marg.adhesion	Epith.c.size	Bare.nuclei
## 1	5	1	1	1	2	1
## 2	5	4	4	5	7	10
## 3	3	1	1	1	2	2
## 4	6	8	8	1	3	4
## 5	4	1	1	3	2	1
## 6	8	10	10	8	7	10

##	Bl.cromatin	Normal.nucleoli	Mitoses	y
## 1	3	1	1	-1
## 2	3	2	1	-1
## 3	3	1	1	-1
## 4	3	7	1	-1
## 5	3	1	1	-1
## 6	9	7	1	1

We now create a *training* and *testing* datasets, and compute the estimator using the **GBM** classifier:

We define a function `breast_err_calculation` that will modify the data, and will depend on the number of trees and the number of K-fold cross-validations.

```
breast_err_calculation <- function(dataset, ntrees = 1000, cv_folds = 10){
  # Creating fraction of the training/testing dataset
  trn_idx <- sample(1:nrow(dataset), size = 0.8*nrow(dataset))
  bc_trn <- dataset[ trn_idx,]
  bc_tst <- dataset[-trn_idx,]
  ## GBM Classifier
  bc_trn$y <- (bc_trn$y + 1)/2 ## convert (-1, 1) to (0, 1)
  bc_tst$y <- (bc_tst$y + 1)/2 ## convert (-1, 1) to (0, 1)
  # Computing the GBM classifier
  bc_fit <- gbm(y ~ .,
               distribution = 'bernoulli',
               data=bc_trn,
               n.trees = ntrees,
               cv.folds = cv_folds)
  # Estimating errors
  pre_tst <- predict(bc_fit, bc_tst, n.trees=bc_fit$n.trees, type='response') > 0.5
  gmb_err_mean <- mean(pre_tst == bc_tst$y)

  return(gmb_err_mean)
}
```

We can now compute the errors for each of the different types of `n.trees`:

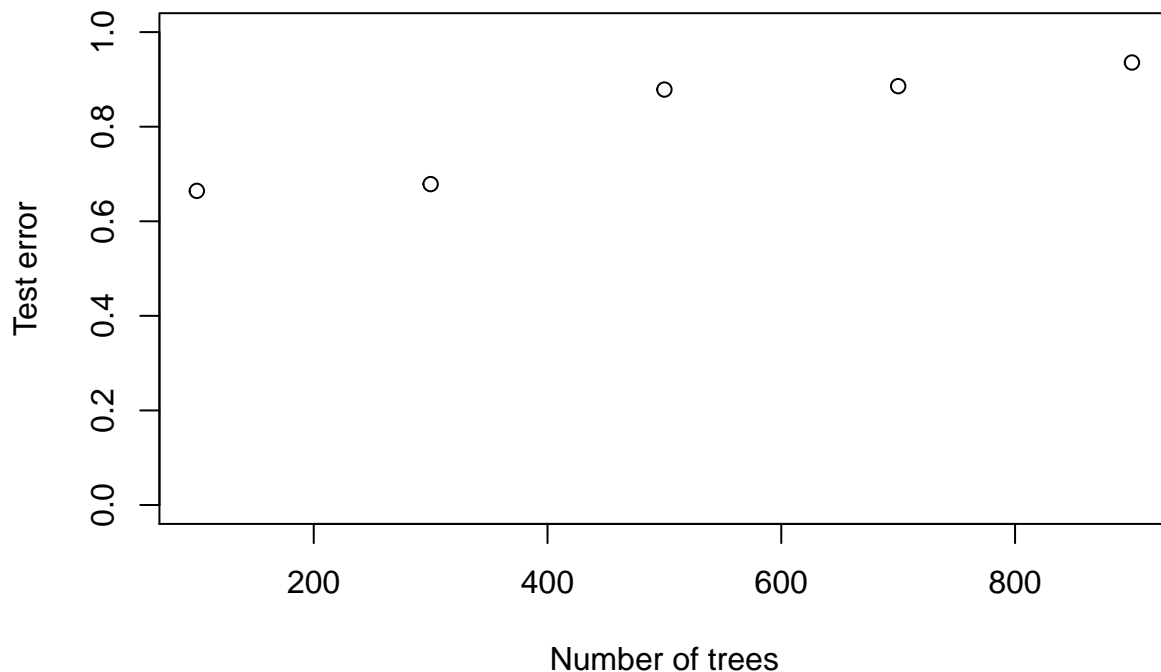
```
## Looping over different values of `n_trees`

n_trees_arr <- seq(100, 1000, 200)
gm_err_arr  <- rep(0, length(n_trees_arr))

for (x in 1:length(n_trees_arr)) {
  gm_err_arr[x] = breast_err_calculation(BreastCancer, ntrees = n_trees_arr[x])
}
```

Now we can go ahead and plot the results of `n_trees_arr` and `gm_err_arr`:

```
plot(n_trees_arr,
     gm_err_arr,
     xlab = 'Number of trees',
     ylab = 'Test error',
     xlim = c(min(n_trees_arr), max(n_trees_arr)),
     ylim = c(0,1))
```



Exercise 2

Using the income data from previous examples to fit a boosted tree ('gbm') for predicting income, given education and seniority. Be sure to read through the help file to make the appropriate modifications.

```
inc <- read.csv(url("http://www-bcf.usc.edu/~gareth/ISL/Income2.csv"),
               header=T, row.names = 1)
```

Exercise 3

Create a figure using the ‘persp’ function to display the prediction surface of the boosted tree model trained in part 1. (hint: use the ‘plot_inc_data’ function from previous lab)
