데이터마이닝이론

STA6600

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Homework 11

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Note : Consider only a classification problem. That is, there is a variable which indicates classes. The location of the class variable is not fixed. Make your program to handle more than two classes. You can assume that values of the class variable are integers starting with 1. Assume your data has both numerical and categorical variables. Further assume that the categorical variables are coded as integers starting with 1. You may use one of two (R or Python) language for this assignment.

1. Prompt the user to type in the filename of the training data.
2. Prompt the user to enter the locations of the categorical variables and the class variables.
3. Prompt the user to enter the filename of the test dataset. (Assume the column location of the class variable is as same as that of the training dataset.)
4. Perform Bagging depending on the choice by the user.
5. For Bagging Ensemble method, use (1) decision trees with depth 2 and (2) decision trees with depth 4 as the classifier and 51 bootstraps as the number of re-sampled data.

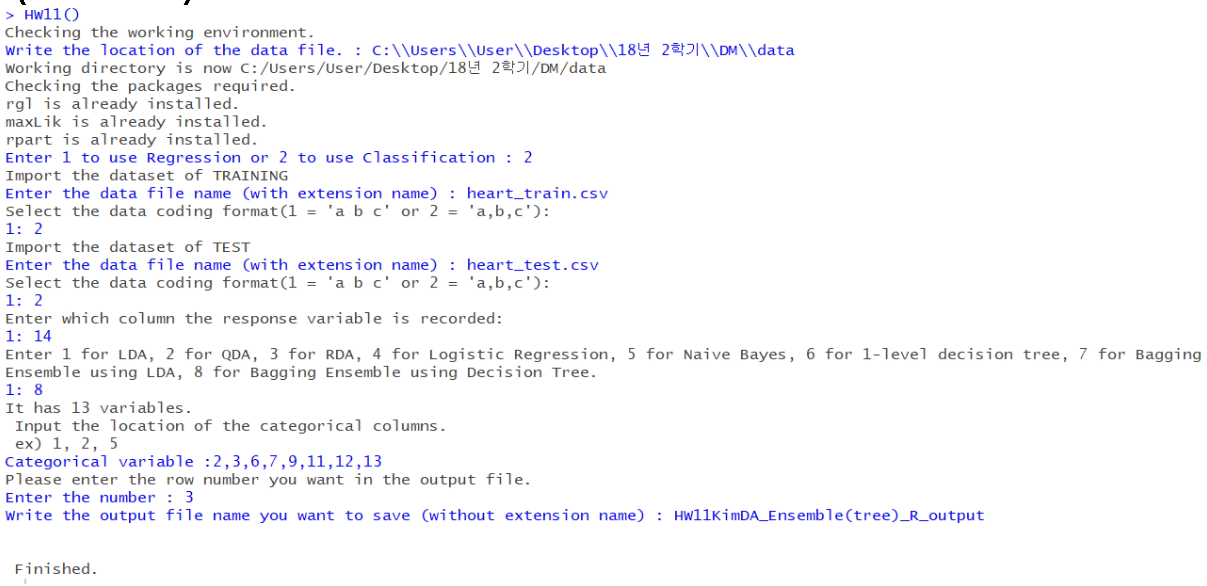
(R code) – 필요부분만 발췌

```
##############################################################
##### 0. Checking the working environment & make importing function #####
##############################################################

# check working library
mylib = function() {
   mylib = readline('Write the location of the data file. : ')
   setwd(mylib)
   cat('Working directory is now', getwd(),'\n')
}

# check installed package
is.install = function(package) {
   if(!is.element(package, installed.packages()[,1])) {install.packages(package)}
   else {cat(package,"is already installed. \n")}
}

# importing dataset function
read = function() {
   data = readline("Enter the data file name (with extension name) : " )
   cat("Select the data coding format(1 = 'a b c' or 2 = 'a,b,c'): ")
   fm = scan(n=1, quiet=TRUE)
   if(fm == 1){form=""} else {form=","}
   read.table(data, sep=form)
}

##############################
##### 2. classification function #####
##############################

classification <- function() {
   ###################### General background #######################
   # import training & test data file
   cat('Import the dataset of TRAINING','\n')
   train = read()
   cat('Import the dataset of TEST','\n')
   test = read()
```

```
# enter the Column number
cat("Enter which column the response variable is recorded: ")
num = scan(n=1, quiet=TRUE)

# nclass of response variable
k = length(unique(train[,num]))    # Assume that values of the class variable are integers starting with 1

 # choose the classification method
    cat("Enter 1 for LDA, 2 for QDA, 3 for RDA, 4 for Logistic Regression, 5 for Naive Bayes, 6 for 1-level
 decision tree, 7 for Bagging Ensemble using LDA, 8 for Bagging Ensemble using Decision Tree.")
    choice = scan(n=1, quiet=TRUE)

    # do not prompt (iv) (v) (vi) when the data has more than 2 classes.
       if(k>2&choice==4|k>2&choice==5|k>2&choice==6) {stop('Cannot run chosen method since data has
 more than 2 classes.') }

##############################################
### (viii) Bagging Ensemble using Decision Tree ###
##############################################

if(choice==8) {
   library(rpart)
   n = nrow(train)
   n.t = nrow(test)
   y = train[,num]
   y.t = test[,num]
   x = train[,-num]
   p = ncol(train)-1
   k = length(unique(train[,num]))
   cat('It has', p,'independent variables.','\n',
         'Input the location of the categorical columns.','\n',
         'ex) 1, 2, 5','\n')
   cate = as.numeric(strsplit(readline('Categorical variable :'),split=",")[[1]])

   for (i in cate) {
      train[,i] <- as.factor(train[,i])
      test[,i] <- as.factor(test[,i])
   }

   ##### (1) Tree with depth 2 #####
   # 51 bootstraps
   id = c(1:n)
   result_d2 = matrix(nrow=n.t, ncol=51)
   bootstrap = c()
   names(train)[num]<-paste('y')
   names(test)[num]<-paste('y')

   for(i in 1:51) {
      set.seed(i*2)
      bootstrap = train[sample(id, n, replace=TRUE),]
      m = rpart(y ~ ., data=bootstrap, method='class', control = list(maxdepth=2))
      p = predict(m, test, type='class')
      result_d2[,i] = p
   }
   c_d2 = apply( result_d2, 1, function(x) names(which.max(table(x))) )

   # output
   cat('Please enter the row number you want in the output file.')
   out_num = as.numeric(readline('Enter the number : '))
   predict_d2 = head(cbind(c(1:n.t), y.t, c_d2), n=out_num)
   table_d2 = table(y.t, c_d2, dnn=c("Actual Class","Predicted Class"))
   accuracy_d2 = sum(diag(table_d2))/sum(table_d2)
```

```
    ##### (2) Tree with depth 4 #####
    # 51 bootstraps
    id = c(1:n)
    result_d4 = matrix(nrow=n.t, ncol=51)
    bootstrap = c()

    for(i in 1:51) {
      set.seed(i*4)
      bootstrap = train[sample(id, n, replace=TRUE),]
      m = rpart(y ~ . , data=bootstrap, method='class', control = list(maxdepth=4))
      p = predict(m, test, type='class')
      result_d4[,i] = p
    }
    c_d4 = apply( result_d4, 1, function(x) names(which.max(table(x))) )

    # output
    predict_d4 = head(cbind(c(1:n.t), y.t, c_d4), n=out_num)
    table_d4 = table(y.t, c_d4, dnn=c("Actual Class","Predicted Class"))
    accuracy_d4 = sum(diag(table_d4))/sum(table_d4)

    # make output file
    outputname = readline("Write the output file name you want to save (without extension name) : ")
    outputname = paste(outputname,".txt",sep="")
    cat('     (1) Tree with depth 2', '\n', file = outputname, sep="")
    cat("ID, Actual class, tree-depth2 pred", "\n", "----------------------------", "\n", file = outputname, sep="",
append=TRUE)
    write.table(predict_d2, outputname, sep= ", ", row.names=FALSE, col.names=FALSE, append=TRUE,
quote=FALSE)
    cat('(continue)','\n','\n', file = outputname, sep="", append = TRUE)
    cat('Confusion Matrix (tree-depth2)', "\n", "---------------------------------", "\n",file = outputname,sep="",
append=TRUE)
    capture.output(print(table_d2), file=outputname, append=TRUE)
    cat("\n", "Model Summary (tree-depth2)", "\n", "-----------------------------", "\n",file = outputname, sep="",
append=TRUE)
    cat("Overall accuracy: ", round(accuracy_d2, 3), "\n\n",file = outputname, sep="", append=TRUE)

    cat('     (2) Tree with depth 4', '\n', file = outputname, sep="", append=TRUE)
    cat("ID, Actual class, tree-depth4 pred", "\n", "----------------------------", "\n",file = outputname,sep="",
append=TRUE)
    write.table(predict_d4, file=outputname, sep= ", ", row.names=FALSE, col.names=FALSE,
append=TRUE, quote=FALSE)
    cat('(continue)',"\n",'\n', file = outputname, sep="", append = TRUE)
    cat('Confusion Matrix (tree-depth4)', "\n", "---------------------------------", "\n",file = outputname,sep="",
append=TRUE)
    capture.output(print(table_d4), file=outputname,append=TRUE)
    cat("\n", "Model Summary (tree-depth4)", "\n", "-----------------------------", "\n",file = outputname,sep="",
append=TRUE)
    cat("Overall accuracy: ", round(accuracy_d4, 3), "\n" ,file = outputname,sep="", append=TRUE)
 }}

HW11 = function(){
  cat('Checking the working environment. \n')
  mylib()
  cat('Checking the packages required. \n')
  is.install('rgl')
  is.install('maxLik')
  is.install('rpart')
  ans = readline('Enter 1 to use Regression or 2 to use Classification : ')
  if (ans==1) { regression() }
  if (ans==2) {classification()}
  cat('\n', '\n', 'Finished.')
}
```

(R console)

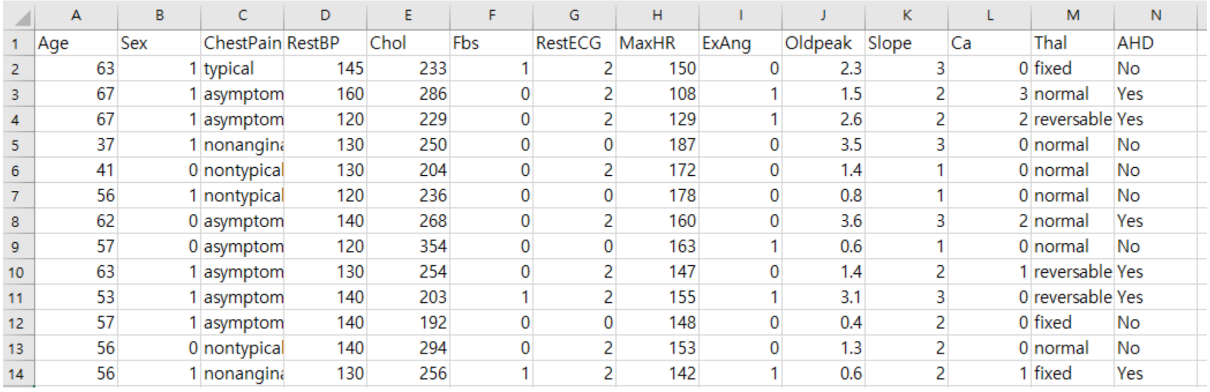


```
> HW11()
Checking the working environment.
Write the location of the data file. : C:\\Users\\User\\Desktop\\18년 2학기\\DM\\data
Working directory is now C:/Users/User/Desktop/18년 2학기/DM/data
Checking the packages required.
rgl is already installed.
maxLik is already installed.
rpart is already installed.
Enter 1 to use Regression or 2 to use Classification : 2
Import the dataset of TRAINING
Enter the data file name (with extension name) : heart_train.csv
Select the data coding format(1 = 'a b c' or 2 = 'a,b,c'):
1: 2
Import the dataset of TEST
Enter the data file name (with extension name) : heart_test.csv
Select the data coding format(1 = 'a b c' or 2 = 'a,b,c'):
1: 2
Enter which column the response variable is recorded:
1: 14
Enter 1 for LDA, 2 for QDA, 3 for RDA, 4 for Logistic Regression, 5 for Naive Bayes, 6 for 1-level decision tree, 7 for Bagging
Ensemble using LDA, 8 for Bagging Ensemble using Decision Tree.
1: 8
It has 13 variables.
 Input the location of the categorical columns.
 ex) 1, 2, 5
Categorical variable :2,3,6,7,9,11,12,13
Please enter the row number you want in the output file.
Enter the number : 3
Write the output file name you want to save (without extension name) : HW11KimDA_Ensemble(tree)_R_output


 Finished.
```

(HW11KimDA_Ensemble(tree)_R_output)

```
    (1) Tree with depth 2
ID, Actual class, tree-depth2 pred
-----------------------------
1, 1, 1
2, 1, 1
3, 1, 2
(continue)

Confusion Matrix (tree-depth2)
----------------------------------
                 Predicted Class
Actual Class    1    2
                1 35 11
                2    6 38

Model Summary (tree-depth2)
------------------------------
Overall accuracy: 0.811

    (2) Tree with depth 4
ID, Actual class, tree-depth4 pred
-----------------------------
1, 1, 1
2, 1, 1
3, 1, 2
(continue)

Confusion Matrix (tree-depth4)
----------------------------------
                 Predicted Class
Actual Class    1    2
                1 37    9
                2    5 39

Model Summary (tree-depth4)
------------------------------
Overall accuracy: 0.844
```

위 분석에 사용한 데이터는 아래와 같다. 심장병 진단과 관련된 13개의 변수가 있는 heart.csv 데이터를 웹에서 다운받아 사용하였다.[i]



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Age	Sex	ChestPain	RestBP	Chol	Fbs	RestECG	MaxHR	ExAng	Oldpeak	Slope	Ca	Thal	AHD
2	63	1	typical	145	233	1	2	150	0	2.3	3	0	fixed	No
3	67	1	asymptom	160	286	0	2	108	1	1.5	2	3	normal	Yes
4	67	1	asymptom	120	229	0	2	129	1	2.6	2	2	reversable	Yes
5	37	1	nonangin	130	250	0	0	187	0	3.5	3	0	normal	No
6	41	0	nontypical	130	204	0	2	172	0	1.4	1	0	normal	No
7	56	1	nontypical	120	236	0	0	178	0	0.8	1	0	normal	No
8	62	0	asymptom	140	268	0	2	160	0	3.6	3	2	normal	Yes
9	57	0	asymptom	120	354	0	0	163	1	0.6	1	0	normal	No
10	63	1	asymptom	130	254	0	2	147	0	1.4	2	1	reversable	Yes
11	53	1	asymptom	140	203	1	2	155	1	3.1	3	0	reversable	Yes
12	57	1	asymptom	140	192	0	0	148	0	0.4	2	0	fixed	No
13	56	0	nontypical	140	294	0	2	153	0	1.3	2	0	normal	No
14	56	1	nonangin	130	256	1	2	142	1	0.6	2	1	fixed	Yes

Heart.csv

Heart.csv 데이터를 Train dataset과 Test dataset으로 분할하기 위해 R의 ‘caret’ package를 사용하여 종속변수인 AHD를 기준으로 train:test = 7:3의 비율로 층화추출을 시행하였다. 213개의 row인 Train dataset과 90개의 row인 Test dataset을 heart_train, heart_test로 저장하였다. 코드는 아래와 같다.

```
library(caret)
intrain = createDataPartition(y=data$AHD, p=0.7, list=FALSE)
train = data[intrain, ]
test = data[-intrain, ]
write.csv(train, 'heart_train.csv')
write.csv(test, 'heart_test.csv')
```

HW11() 함수를 실행하면 유저가 Prompt 창에 working directory를 지정하고 Regression은 1을, Classification은 2를 입력하고, Decision Tree를 이용한 Bagging Ensemble을 직접 실행할 수 있도록 하였다. heart_train과 heart_test를 이용한 Bagging Ensemble의 실행코드는 아래와 같다.

```
HW11()
C:\\Users\\User\\Desktop\\18년 2학기\\DM\\data
2
heart_train.csv
2
heart_test.csv
2
14
8
2,3,6,7,9,11,12,13
3
HW11KimDA_Ensemble(tree)_R_output
```

이 코드의 수행 결과는 앞 쪽에 첨부되어 있다.

[i] http://www-bcf.usc.edu/~gareth/ISL/data.html