Ensemble_Learning_MU3D

2022-11-03

load packages

```
library(reshape2)
```

```
## Warning: package 'reshape2' was built under R version 4.2.2
```

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.2.2
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2 ──
## ✓ ggplot2 3.4.0      ✓ purrr   0.3.5
## ✓ tibble  3.1.8      ✓ dplyr   1.0.10
## ✓ tidyr   1.2.1      ✓ stringr 1.4.1
## ✓ readr   2.1.3      ✓ forcats 0.5.2
```

```
## Warning: package 'ggplot2' was built under R version 4.2.2
```

```
## Warning: package 'stringr' was built under R version 4.2.2
```

```
## Warning: package 'forcats' was built under R version 4.2.2
```

```
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✕ dplyr::filter() masks stats::filter()
## ✕ dplyr::lag()    masks stats::lag()
```

```
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.2.2
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(psych)
```

```
## Warning: package 'psych' was built under R version 4.2.2
```

```
##
## Attaching package: 'psych'
##
## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
```

```
library(corrplot)
```

```
## Warning: package 'corrplot' was built under R version 4.2.2
```

```
## corrplot 0.92 loaded
```

```
library(FactoMineR)
```

```
## Warning: package 'FactoMineR' was built under R version 4.2.2
```

```
library(devtools)
```

```
## Warning: package 'devtools' was built under R version 4.2.2
```

```
## Loading required package: usethis
```

```
## Warning: package 'usethis' was built under R version 4.2.2
```

```
install_github('sinhrks/ggfortify',force = TRUE)
```

```
## WARNING: Rtools is required to build R packages, but is not currently installed.
##
## Please download and install Rtools 4.2 from https://cran.r-project.org/bin/windows/Rtools/ or
https://www.r-project.org/nosvn/winutf8/ucrt3/.
## Downloading GitHub repo sinhrks/ggfortify@HEAD
```

```
## WARNING: Rtools is required to build R packages, but is not currently installed.
##
## Please download and install Rtools 4.2 from https://cran.r-project.org/bin/windows/Rtools/ or
https://www.r-project.org/nosvn/winutf8/ucrt3/.
```

```
##


   checking for file 'C:\Users\kunbu\AppData\Local\Temp\Rtmpu0TFdq\remotes10186aea2106\sinhrks-g
gfortify-c34899a/DESCRIPTION' ...

   checking for file 'C:\Users\kunbu\AppData\Local\Temp\Rtmpu0TFdq\remotes10186aea2106\sinhrks-g
gfortify-c34899a/DESCRIPTION' ...

✔  checking for file 'C:\Users\kunbu\AppData\Local\Temp\Rtmpu0TFdq\remotes10186aea2106\sinhrks-
ggfortify-c34899a/DESCRIPTION'
##



─  preparing 'ggfortify':
##    checking DESCRIPTION meta-information ...

   checking DESCRIPTION meta-information ...

✔  checking DESCRIPTION meta-information
##



─  checking for LF line-endings in source and make files and shell scripts
##



─  checking for empty or unneeded directories
##



─  building 'ggfortify_0.4.15.tar.gz'
##


##
```

```
library(ggfortify)
library(e1071)
```

```
## Warning: package 'e1071' was built under R version 4.2.2
```

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.2.2
```

```
## Loading required package: lattice
##
## Attaching package: 'caret'
##
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(randomForest)
```

```
## Warning: package 'randomForest' was built under R version 4.2.2
```

```
## randomForest 4.7-1.1
## Type rfNews() to see new features/changes/bug fixes.
##
## Attaching package: 'randomForest'
##
## The following object is masked from 'package:psych':
##
##     outlier
##
## The following object is masked from 'package:dplyr':
##
##     combine
##
## The following object is masked from 'package:ggplot2':
##
##     margin
```

import video level dataset

Boxplot for variables

```
#remove veractiy first
MU3D_Video_Level_Data <- MU3D_Video_Level_Data0[,-grep("Veracity",colnames(MU3D_Video_Level_Data
0))]
str(MU3D_Video_Level_Data)
```

```
## 'data.frame':    320 obs. of  13 variables:
##  $ VideoID      : chr  "BF001_1PT" "BF001_2NL" "BF001_3NT" "BF001_4PL" ...
##  $ Valence      : int  1 0 0 1 1 0 0 1 1 0 ...
##  $ Sex          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Race         : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ VidLength_ms : int  38783 37120 38484 38026 36351 36650 29141 36480 36960 29610 ...
##  $ VidLength_sec: num  38.8 37.1 38.5 38 36.4 ...
##  $ WordCount    : int  110 88 120 124 91 73 95 104 91 114 ...
##  $ Accuracy     : num  0.77 0.4 0.77 0.58 0.59 0.33 0.6 0.64 0.64 0.27 ...
##  $ TruthProp    : num  0.77 0.6 0.77 0.42 0.59 0.67 0.6 0.36 0.64 0.73 ...
##  $ Attractive   : num  4.55 3.55 3.27 4.05 4.86 5.05 4.4 4.27 3.09 3 ...
##  $ Trustworthy  : num  4.32 3.75 3.95 4.05 4.36 4.62 4.5 3.73 4.27 4.55 ...
##  $ Anxious      : num  3.18 3.05 2.82 3.11 3.32 2.33 3.15 2.91 2.64 2.73 ...
##  $ Transcription: chr  "My best friend is a really nice person. Um. She’s always kind to ever
yone. She continues to just be herself aro"| __truncated__ "She’s actually really two faced and
not fun to be around. Um she’s really negative. Um. I don’t like the person"| __truncated__ "So
this specific person is actually just a really mean and negative person. Um. I’m not sure why sh
e thinks she"| __truncated__ "This person is actually a really kind person. She has so many frie
nds. She’s very popular. Everyone, um, watche"| __truncated__ ...
```

```
#scaled
colnames(MU3D_Video_Level_Data)
```

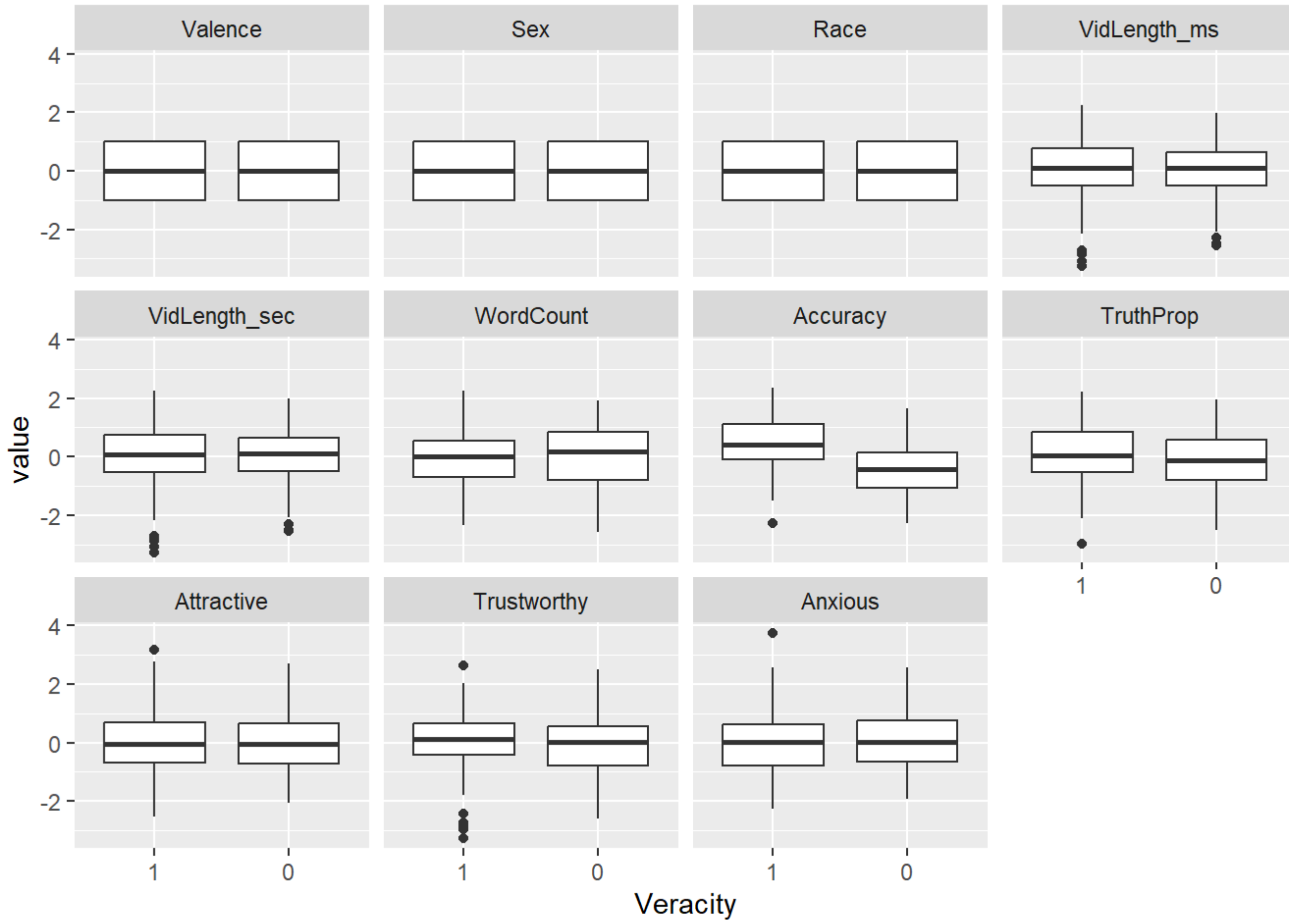
```
##  [1] "VideoID"       "Valence"       "Sex"           "Race"
##  [5] "VidLength_ms"  "VidLength_sec" "WordCount"     "Accuracy"
##  [9] "TruthProp"     "Attractive"    "Trustworthy"   "Anxious"
## [13] "Transcription"
```

```
MU3D_Video_Level_Data.scaled <- data.frame(scale(MU3D_Video_Level_Data[,-grep("VideoID|Transcrip
tion",colnames(MU3D_Video_Level_Data))]))

#level veractiy
levels0 <- unique(c(MU3D_Video_Level_Data0$Veracity, MU3D_Video_Level_Data0$Veracity))
#add veracity back
MU3D_Video_Level_Data.scaled$Veracity <- factor(MU3D_Video_Level_Data0$Veracity,levels = levels
0)

#melt data for boxplot
MU3D_Video_Level_Data.scaled.melt <- melt(MU3D_Video_Level_Data.scaled, id.var = "Veracity")

#plot boxplot
ggplot(data = MU3D_Video_Level_Data.scaled.melt, aes(x=Veracity, y = value))+
  geom_boxplot() +
  facet_wrap(~variable, ncol=4)
```



Feature Selection

```
# ensure results are repeatable
set.seed(7)
# load the library
library(mlbench)
```

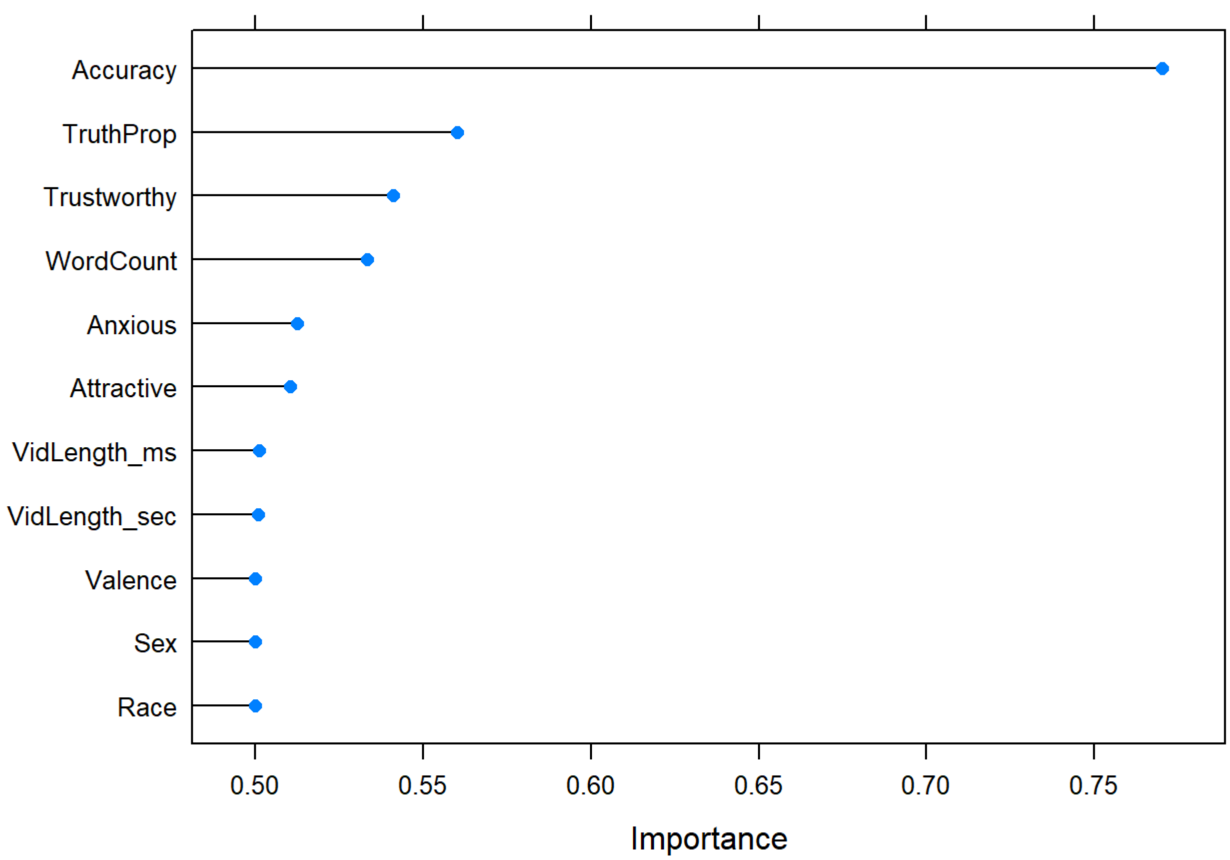
```
## Warning: package 'mlbench' was built under R version 4.2.2
```

```
library(caret)

# prepare training scheme
control <- trainControl(method="repeatedcv", number=10, repeats=3)
# train the model
model <- train(Veracity~., data=MU3D_Video_Level_Data.scaled, method="lvq", preProcess="scale",
 trControl=control)
# estimate variable importance
importance <- varImp(model, scale=FALSE)
# summarize importance
print(importance)
```

```
## ROC curve variable importance
##
##                  Importance
## Accuracy             0.7701
## TruthProp            0.5601
## Trustworthy          0.5410
## WordCount            0.5333
## Anxious              0.5125
## Attractive           0.5104
## VidLength_ms         0.5011
## VidLength_sec        0.5009
## Sex                  0.5000
## Valence              0.5000
## Race                 0.5000
```

```
# plot importance
plot(importance)
```




```
features <- colnames(MU3D_Video_Level_Data.scaled[,importance$importance$X0>=0.51])
```

Individual learning classifer

Splitting data set into training and test datasets using 80/20 cretira.

```
#split train and test 80/20
set.seed(123)
smp_size_raw <- floor(0.80 * nrow(MU3D_Video_Level_Data.scaled))
train_ind_raw <- sample(nrow(MU3D_Video_Level_Data.scaled), size = smp_size_raw)
train_raw.df <- as.data.frame(MU3D_Video_Level_Data.scaled[train_ind_raw, importance$importance
$X0>=0.51])
test_raw.df <- as.data.frame(MU3D_Video_Level_Data.scaled[-train_ind_raw, importance$importance
$X0>=0.51])
train_raw.df$Veracity <- MU3D_Video_Level_Data.scaled[train_ind_raw, 12]
test_raw.df$Veracity <- MU3D_Video_Level_Data.scaled[-train_ind_raw, 12]
```

SVM

```
poly.tune <- tune.svm(Veracity ~ ., data = train_raw.df,
                      kernel = "polynomial",
                      degree = c(2, 3, 4, 5, 6),
                      coef0 = c(0.1, 0.5, 1, 2, 3, 4))
summary(poly.tune) #best degree is 4,coef0 = 2,  misclassification rate no larger than 12.87%
```

```
##
## Parameter tuning of 'svm':
##
## - sampling method: 10-fold cross validation
##
## - best parameters:
##  degree coef0
##       4     4
##
## - best performance: 0.1212308
##
## - Detailed performance results:
##    degree coef0     error dispersion
## 1       2   0.1 0.2187692 0.08477778
## 2       3   0.1 0.2190769 0.07740091
## 3       4   0.1 0.2809231 0.08762541
## 4       5   0.1 0.3198462 0.09631050
## 5       6   0.1 0.3393846 0.09094493
## 6       2   0.5 0.2153846 0.08745958
## 7       3   0.5 0.1923077 0.08548889
## 8       4   0.5 0.1924615 0.08580960
## 9       5   0.5 0.1884615 0.08634975
## 10      6   0.5 0.1884615 0.09945611
## 11      2   1.0 0.2153846 0.09278226
## 12      3   1.0 0.1607692 0.06875716
## 13      4   1.0 0.1804615 0.08473511
## 14      5   1.0 0.1607692 0.07611974
## 15      6   1.0 0.1524615 0.09130639
## 16      2   2.0 0.2153846 0.10125316
## 17      3   2.0 0.1569231 0.07513827
## 18      4   2.0 0.1333846 0.08342141
## 19      5   2.0 0.1444615 0.08240134
## 20      6   2.0 0.1447692 0.08342267
## 21      2   3.0 0.2113846 0.08681432
## 22      3   3.0 0.1607692 0.07319963
## 23      4   3.0 0.1252308 0.08762841
## 24      5   3.0 0.1567692 0.10907886
## 25      6   3.0 0.1413846 0.10289805
## 26      2   4.0 0.2152308 0.08481081
## 27      3   4.0 0.1489231 0.06117328
## 28      4   4.0 0.1212308 0.09574182
## 29      5   4.0 0.1449231 0.10847530
## 30      6   4.0 0.1295385 0.10254051
```

```
best.poly <- poly.tune$best.model
poly.test <- predict(best.poly, newdata = test_raw.df)
table(poly.test, test_raw.df$Veracity)
```

```
##
## poly.test  1  0
##         1 27  8
##         0  2 27
```

```
confusionMatrix(poly.test, test_raw.df$Veracity, dnn = c("Prediction", "Reference"))
```

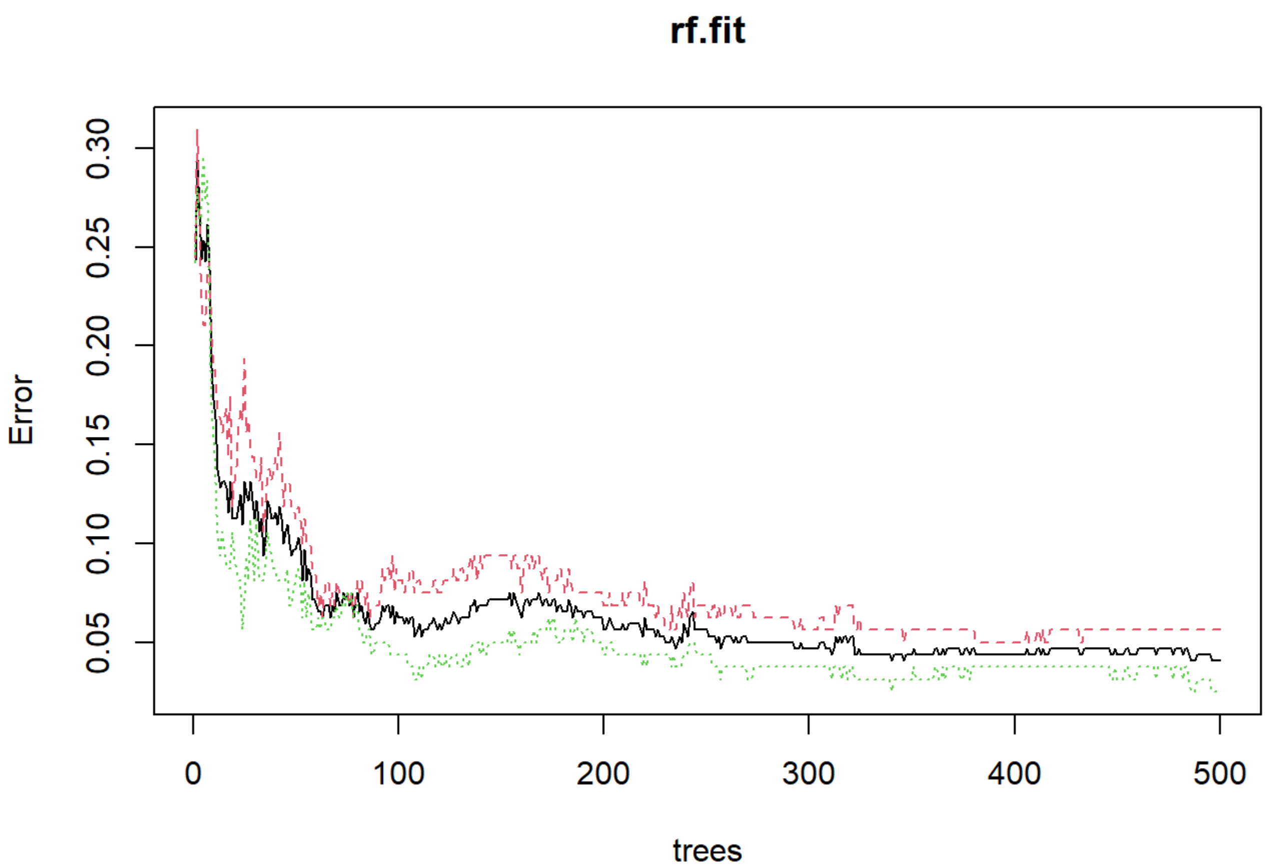
```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  1  0
##          1 27  8
##          0  2 27
##
##                Accuracy : 0.8438
##                  95% CI : (0.7314, 0.9224)
##     No Information Rate : 0.5469
##     P-Value [Acc > NIR] : 4.925e-07
##
##                   Kappa : 0.6902
##
##  Mcnemar's Test P-Value : 0.1138
##
##             Sensitivity : 0.9310
##             Specificity : 0.7714
##          Pos Pred Value : 0.7714
##          Neg Pred Value : 0.9310
##              Prevalence : 0.4531
##          Detection Rate : 0.4219
##    Detection Prevalence : 0.5469
##       Balanced Accuracy : 0.8512
##
##        'Positive' Class : 1
##
```

Random Forest

```
set.seed(123)
rf.fit <- randomForest(Veracity~., data= MU3D_Video_Level_Data.scaled)
rf.fit
```

```
##
## Call:
##  randomForest(formula = Veracity ~ ., data = MU3D_Video_Level_Data.scaled)
##                Type of random forest: classification
##                      Number of trees: 500
## No. of variables tried at each split: 3
##
##         OOB estimate of  error rate: 4.06%
## Confusion matrix:
##     1   0 class.error
## 1 151   9     0.05625
## 0   4 156     0.02500
```

```
plot(rf.fit)
```

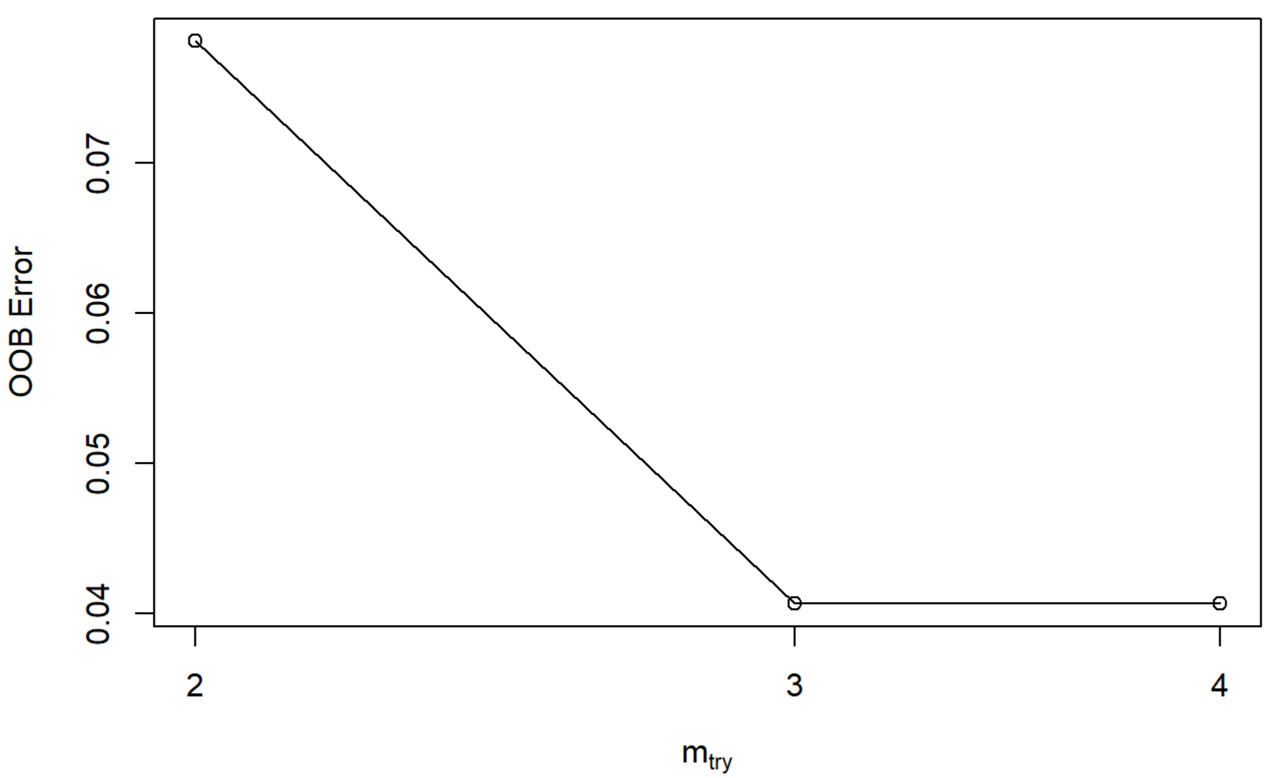



```
which.min(rf.fit$err.rate[,1])
```

```
## [1] 340
```

```
set.seed(123)
mtry <- tuneRF(MU3D_Video_Level_Data.scaled[,-12],MU3D_Video_Level_Data.scaled$Veracity, ntreeTr
y=1000,
               stepFactor=1.5,improve=0.01, trace=TRUE, plot=TRUE)
```

```
## mtry = 3  OOB error = 4.06%
## Searching left ...
## mtry = 2     OOB error = 7.81%
## -0.9230769 0.01
## Searching right ...
## mtry = 4     OOB error = 4.06%
## 0 0.01
```




```
best.m <- mtry[mtry[,2] == min(mtry[,2]), 1]
print(mtry)
```

```
##       mtry OOBError
## 2.OOB    2 0.078125
## 3.OOB    3 0.040625
## 4.OOB    4 0.040625
```

```
print(best.m)
```

```
## 3.OOB 4.OOB
##     3     4
```

```
set.seed(123)
rf.fit1 <-randomForest(Veracity~.,data=train_raw.df[,-3], mtry=best.m, importance=TRUE,ntree=334
)
```

```
## Warning in mtry < 1 || mtry > p: 'length(x) = 2 > 1' in coercion to 'logical(1)'

## Warning in mtry < 1 || mtry > p: 'length(x) = 2 > 1' in coercion to 'logical(1)'
```

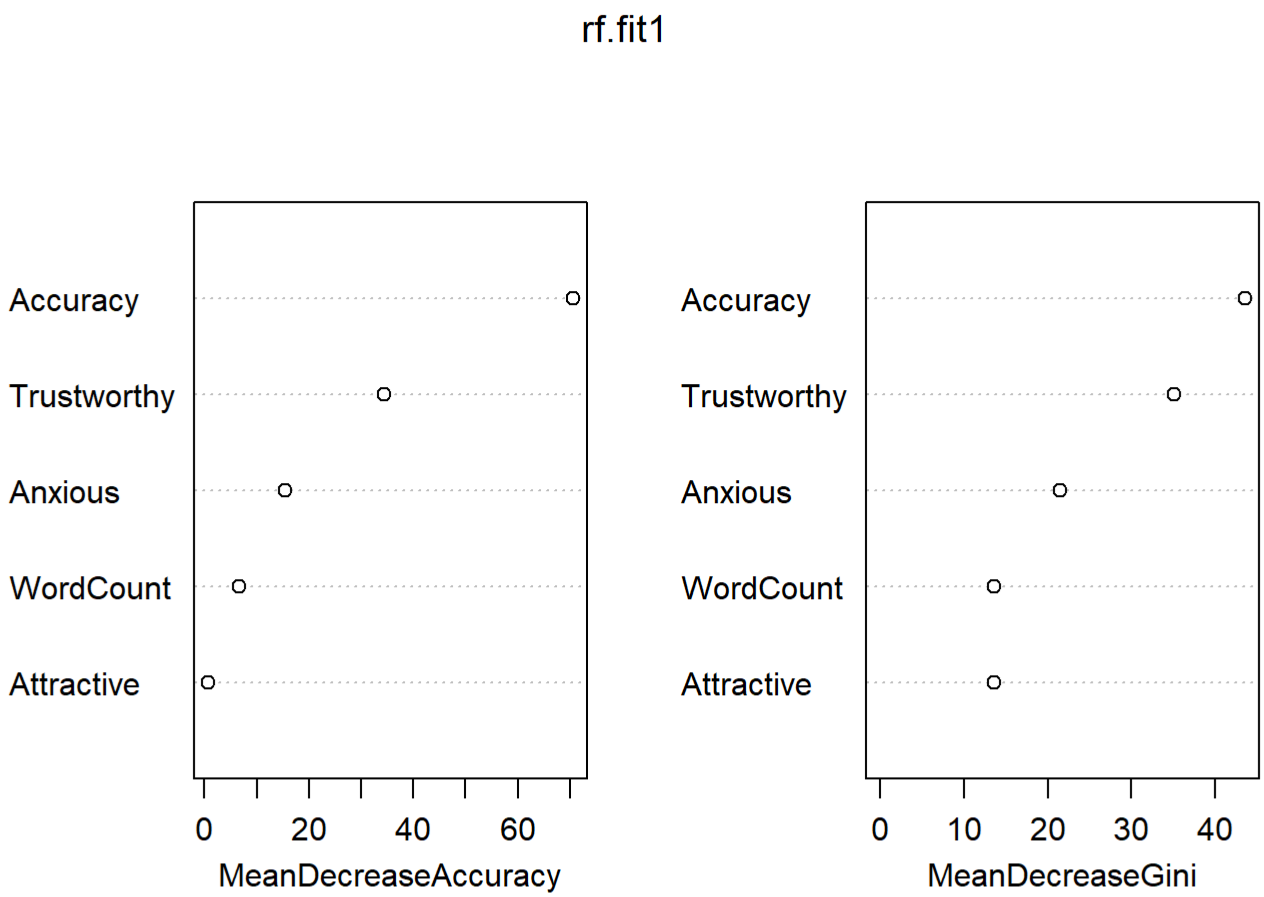
```
print(rf.fit1)
```

```
##
## Call:
##  randomForest(formula = Veracity ~ ., data = train_raw.df[, -3],      mtry = best.m, importan
ce = TRUE, ntree = 334)
##                Type of random forest: classification
##                      Number of trees: 334
## No. of variables tried at each split: 3
##
##         OOB estimate of  error rate: 23.05%
## Confusion matrix:
##    1  0 class.error
## 1 98 33   0.2519084
## 0 26 99   0.2080000
```

```
#Evaluate variable importance
importance(rf.fit1)
```

```
##                     1         0 MeanDecreaseAccuracy MeanDecreaseGini
## WordCount    5.469427  4.019675            6.6861805         13.62865
## Accuracy    51.273047 55.159668           70.5412102         43.57648
## Attractive  -1.342833  2.496349            0.7810218         13.60494
## Trustworthy 24.495995 27.475946           34.4083459         35.15233
## Anxious      6.050911 14.959367           15.4323272         21.47542
```

```
varImpPlot(rf.fit1)
```




```
rf.pred <- predict(rf.fit1, test_raw.df)
confusionMatrix(rf.pred, test_raw.df$Veracity)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  1  0
##          1 22  7
##          0  7 28
##
##                Accuracy : 0.7812
##                  95% CI : (0.6603, 0.8749)
##     No Information Rate : 0.5469
##     P-Value [Acc > NIR] : 8.469e-05
##
##                   Kappa : 0.5586
##
##  Mcnemar's Test P-Value : 1
##
##             Sensitivity : 0.7586
##             Specificity : 0.8000
##          Pos Pred Value : 0.7586
##          Neg Pred Value : 0.8000
##              Prevalence : 0.4531
##          Detection Rate : 0.3438
##    Detection Prevalence : 0.4531
##       Balanced Accuracy : 0.7793
##
##        'Positive' Class : 1
##
```

plot AUC

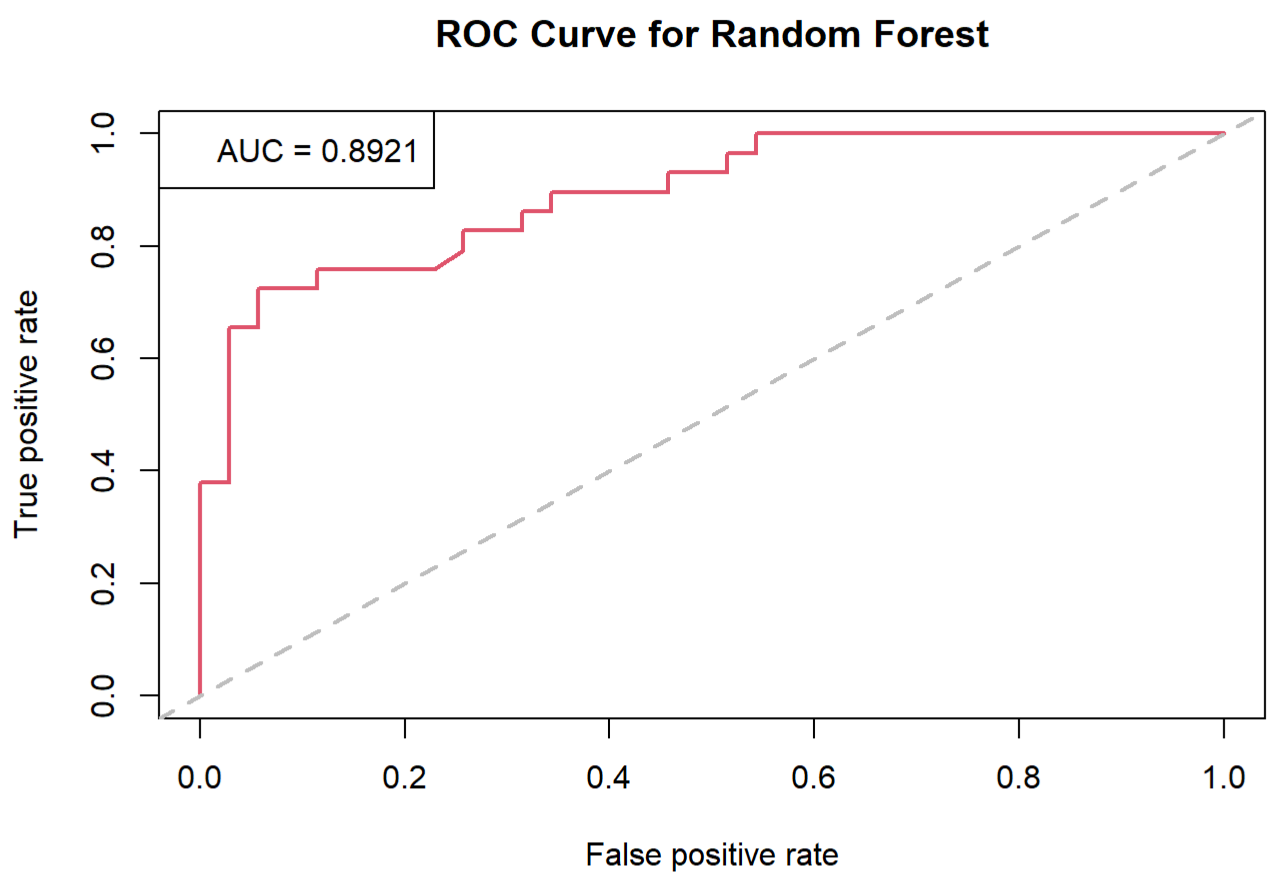
```
set.seed(123)
pred1=predict(rf.fit1, test_raw.df, type = "prob")
library(ROCR)
```

```
## Warning: package 'ROCR' was built under R version 4.2.2
```

```
perf = prediction(pred1[,1], test_raw.df$Veracity)
# 1. Area under curve
auc = performance(perf, "auc")
auc@y.values[[1]]
```

```
## [1] 0.8921182
```

```
# 2. True Positive and Negative Rate
pred3 = performance(perf, "tpr","fpr")
# 3. Plot the ROC curve
plot(pred3,main="ROC Curve for Random Forest",col=2,lwd=2)
abline(a=0,b=1,lwd=2,lty=2,col="gray")
legend("topleft", c(paste0("AUC = ", round(auc@y.values[[1]],4))))
```



KNN

```
library(class)

target_category <- train_raw.df$Veracity
test_category <- test_raw.df$Veracity
k=sqrt(dim(MU3D_Video_Level_Data)[1])
##run knn function
knn.fit <- knn(train_raw.df,test_raw.df,cl=target_category,k=k)

##create confusion matrix
confusionMatrix(knn.fit, test_raw.df$Veracity, dnn = c("Prediction", "Reference"))
```

```
## Confusion Matrix and Statistics
## 
##           Reference
## Prediction  1  0
##          1 29  0
##          0  0 35
##                                      
##                Accuracy : 1          
##                  95% CI : (0.944, 1)
##     No Information Rate : 0.5469     
##     P-Value [Acc > NIR] : < 2.2e-16  
##                                      
##                   Kappa : 1          
##                                      
##  Mcnemar's Test P-Value : NA         
##                                      
##             Sensitivity : 1.0000     
##             Specificity : 1.0000     
##          Pos Pred Value : 1.0000     
##          Neg Pred Value : 1.0000     
##              Prevalence : 0.4531     
##          Detection Rate : 0.4531     
##    Detection Prevalence : 0.4531     
##       Balanced Accuracy : 1.0000     
##                                      
##        'Positive' Class : 1          
## 
```

GLM

```
##run glm function
glm.fit <- glm(Veracity~. ,family = binomial(link = "logit"), train_raw.df,)
outcome <- predict(glm.fit, newdata = test_raw.df, type = 'response')
outcome1 <- as.factor(ifelse(outcome > 0.5, 1, 0))
##create confusion matrix
confusionMatrix(data = outcome1, test_raw.df$Veracity, dnn = c("Prediction", "Reference"))
```

```
## Warning in confusionMatrix.default(data = outcome1, test_raw.df$Veracity, :
## Levels are not in the same order for reference and data. Refactoring data to
## match.
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  1  0
##          1  9 23
##          0 20 12
##
##                Accuracy : 0.3281
##                  95% CI : (0.2159, 0.4569)
##     No Information Rate : 0.5469
##     P-Value [Acc > NIR] : 0.9999
##
##                   Kappa : -0.3438
##
##  Mcnemar's Test P-Value : 0.7604
##
##             Sensitivity : 0.3103
##             Specificity : 0.3429
##          Pos Pred Value : 0.2812
##          Neg Pred Value : 0.3750
##              Prevalence : 0.4531
##          Detection Rate : 0.1406
##    Detection Prevalence : 0.5000
##       Balanced Accuracy : 0.3266
##
##        'Positive' Class : 1
##
```

WSRF

```
#install.packages("wsrf")
library(wsrf)
```

```
## Warning: package 'wsrf' was built under R version 4.2.2
```

```
## Loading required package: parallel
```

```
## Loading required package: Rcpp
```

```
## wsrf: An R Package for Scalable Weighted Subspace Random Forests.
```

```
## Version 1.7.27
```

```
## Use C++ standard thread library for parallel computing
```

```
##
## Attaching package: 'wsrf'
```

```
## The following objects are masked from 'package:randomForest':
##
##     combine, importance
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

```
target <- "Veracity"
ds <- MU3D_Video_Level_Data.scaled
vars <- names(ds)

if (sum(is.na(ds[vars]))) ds[vars] <- na.roughfix(ds[vars])
ds[target] <- as.factor(ds[[target]])
(tt <- table(ds[target]))
```

```
## Veracity
##   1   0
## 160 160
```

```
form <- as.formula(paste(target, "~ ."))

model.wsrf.1 <- wsrf(form, data=train_raw.df, parallel=FALSE)
print(model.wsrf.1)
```

```
## A Weighted Subspace Random Forest model with 500 trees.
##
##   No. of variables tried at each split: 3
##         Minimum size of terminal nodes: 2
##                  Out-of-Bag Error Rate: 0.05
##                               Strength: 0.77
##                            Correlation: 0.07
##
## Confusion matrix:
##     1   0 class.error
## 1 125   6        0.05
## 0   7 118        0.06
```

```
wdrf.fit <- predict(model.wsrf.1, newdata=test_raw.df, type="class")$class

##create confusion matrix
confusionMatrix(wdrf.fit, test_raw.df$Veracity, dnn = c("Prediction", "Reference"))
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  1  0
##          1 29  3
##          0  0 32
##
##                Accuracy : 0.9531
##                  95% CI : (0.8691, 0.9902)
##     No Information Rate : 0.5469
##     P-Value [Acc > NIR] : 4.219e-13
##
##                   Kappa : 0.9062
##
##  Mcnemar's Test P-Value : 0.2482
##
##             Sensitivity : 1.0000
##             Specificity : 0.9143
##          Pos Pred Value : 0.9062
##          Neg Pred Value : 1.0000
##              Prevalence : 0.4531
##          Detection Rate : 0.4531
##    Detection Prevalence : 0.5000
##       Balanced Accuracy : 0.9571
##
##        'Positive' Class : 1
##
```

GBM

```
#install.packages("gbm")
library(gbm)
```

```
## Warning: package 'gbm' was built under R version 4.2.2
```

```
## Loaded gbm 2.1.8.1
```

```
fit.gbm <- gbm(Veracity~. , data= train_raw.df,
               distribution = 'multinomial',
               cv.folds = 10,
               shrinkage = .01,
               n.minobsinnode = 10,
               n.trees = 200)
```

```
## Warning: Setting `distribution = "multinomial"` is ill-advised as it is
## currently broken. It exists only for backwards compatibility. Use at your own
## risk.
```

```r
pred <- predict.gbm(object = fit.gbm,
                    newdata = test_raw.df,
                    n.trees = 200,
                    type = "response")

##create confusion matrix
pred.labels = colnames(pred)[apply(pred, 1, which.max)]
result = data.frame(test_raw.df$Veracity, pred.labels)
caret::confusionMatrix(test_raw.df$Veracity, as.factor(pred.labels))
```

```
## Warning in confusionMatrix.default(test_raw.df$Veracity,
## as.factor(pred.labels)): Levels are not in the same order for reference and
## data. Refactoring data to match.
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 19 16
##          1  7 22
##
##                Accuracy : 0.6406
##                  95% CI : (0.511, 0.7568)
##     No Information Rate : 0.5938
##     P-Value [Acc > NIR] : 0.26403
##
##                   Kappa : 0.2937
##
##  Mcnemar's Test P-Value : 0.09529
##
##             Sensitivity : 0.7308
##             Specificity : 0.5789
##          Pos Pred Value : 0.5429
##          Neg Pred Value : 0.7586
##              Prevalence : 0.4062
##          Detection Rate : 0.2969
##    Detection Prevalence : 0.5469
##       Balanced Accuracy : 0.6549
##
##        'Positive' Class : 0
##
```

Ensemble Learning

```r
library(caretEnsemble)
```

```
## Warning: package 'caretEnsemble' was built under R version 4.2.2
```

```
##
## Attaching package: 'caretEnsemble'
```

```
## The following object is masked from 'package:ggplot2':
##
##     autoplot
```

```
set.seed(100)

control_stacking <- caret::trainControl(method="repeatedcv", number=5, repeats=2, savePrediction
s=TRUE, classProbs=TRUE)
algorithms_to_use <- c( 'glm', 'knn', 'svmPoly','svmLinear', 'wsrf',  'gbm')
stacked_models <- caretList(make.names(Veracity) ~., data=MU3D_Video_Level_Data.scaled, trContro
l=control_stacking, methodList=algorithms_to_use)
```

```
## Warning in trControlCheck(x = trControl, y = target): x$savePredictions == TRUE
## is depreciated. Setting to 'final' instead.
```

```
## Warning in trControlCheck(x = trControl, y = target): indexes not defined in
## trControl. Attempting to set them ourselves, so each model in the ensemble will
## have the same resampling indexes.
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3583             nan     0.1000    0.0133
##      2        1.3382             nan     0.1000    0.0078
##      3        1.3199             nan     0.1000    0.0074
##      4        1.2949             nan     0.1000    0.0115
##      5        1.2803             nan     0.1000    0.0065
##      6        1.2638             nan     0.1000    0.0080
##      7        1.2515             nan     0.1000    0.0048
##      8        1.2403             nan     0.1000    0.0020
##      9        1.2342             nan     0.1000    0.0000
##     10        1.2277             nan     0.1000    0.0008
##     20        1.1541             nan     0.1000   -0.0007
##     40        1.0918             nan     0.1000   -0.0013
##     60        1.0528             nan     0.1000   -0.0017
##     80        1.0171             nan     0.1000   -0.0025
##    100        0.9827             nan     0.1000   -0.0034
##    120        0.9603             nan     0.1000   -0.0005
##    140        0.9401             nan     0.1000   -0.0003
##    150        0.9265             nan     0.1000   -0.0029
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2937             nan     0.1000    0.0447
##      2        1.2243             nan     0.1000    0.0341
##      3        1.1633             nan     0.1000    0.0268
##      4        1.1163             nan     0.1000    0.0191
##      5        1.0525             nan     0.1000    0.0248
##      6        1.0281             nan     0.1000    0.0088
##      7        1.0090             nan     0.1000    0.0054
##      8        0.9547             nan     0.1000    0.0265
##      9        0.9201             nan     0.1000    0.0133
##     10        0.8915             nan     0.1000    0.0108
##     20        0.8319             nan     0.1000   -0.0020
##     40        0.6226             nan     0.1000   -0.0008
##     60        0.4704             nan     0.1000    0.0066
##     80        0.3438             nan     0.1000    0.0006
##    100        0.2657             nan     0.1000    0.0056
##    120        0.2219             nan     0.1000   -0.0007
##    140        0.1809             nan     0.1000   -0.0012
##    150        0.1484             nan     0.1000   -0.0007
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2769             nan     0.1000    0.0499
##      2        1.1186             nan     0.1000    0.0781
##      3        1.0262             nan     0.1000    0.0450
##      4        0.9424             nan     0.1000    0.0384
##      5        0.9132             nan     0.1000    0.0090
##      6        0.8140             nan     0.1000    0.0500
##      7        0.7505             nan     0.1000    0.0312
##      8        0.6727             nan     0.1000    0.0387
##      9        0.6577             nan     0.1000    0.0059
##     10        0.6146             nan     0.1000    0.0198
##     20        0.3466             nan     0.1000    0.0153
```

```
##     40        0.2001             nan     0.1000   -0.0009
##     60        0.1530             nan     0.1000   -0.0011
##     80        0.1145             nan     0.1000   -0.0008
##    100        0.0866             nan     0.1000   -0.0004
##    120        0.0640             nan     0.1000    0.0003
##    140        0.0498             nan     0.1000   -0.0006
##    150        0.0427             nan     0.1000   -0.0001
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3562             nan     0.1000    0.0160
##      2        1.3223             nan     0.1000    0.0134
##      3        1.3044             nan     0.1000    0.0067
##      4        1.2859             nan     0.1000    0.0090
##      5        1.2711             nan     0.1000    0.0072
##      6        1.2507             nan     0.1000    0.0076
##      7        1.2345             nan     0.1000    0.0052
##      8        1.2265             nan     0.1000    0.0018
##      9        1.2143             nan     0.1000    0.0047
##     10        1.2049             nan     0.1000    0.0032
##     20        1.1338             nan     0.1000    0.0015
##     40        1.0737             nan     0.1000   -0.0015
##     60        1.0487             nan     0.1000   -0.0040
##     80        1.0207             nan     0.1000   -0.0019
##    100        0.9995             nan     0.1000   -0.0027
##    120        0.9691             nan     0.1000   -0.0012
##    140        0.9453             nan     0.1000   -0.0031
##    150        0.9358             nan     0.1000   -0.0040
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2910             nan     0.1000    0.0431
##      2        1.2202             nan     0.1000    0.0330
##      3        1.1317             nan     0.1000    0.0425
##      4        1.0814             nan     0.1000    0.0226
##      5        0.9961             nan     0.1000    0.0384
##      6        0.9359             nan     0.1000    0.0270
##      7        0.8857             nan     0.1000    0.0238
##      8        0.8759             nan     0.1000    0.0028
##      9        0.8480             nan     0.1000    0.0111
##     10        0.7955             nan     0.1000    0.0239
##     20        0.5915             nan     0.1000   -0.0015
##     40        0.4659             nan     0.1000   -0.0015
##     60        0.3820             nan     0.1000   -0.0015
##     80        0.2680             nan     0.1000    0.0038
##    100        0.1881             nan     0.1000   -0.0008
##    120        0.1379             nan     0.1000    0.0006
##    140        0.1184             nan     0.1000   -0.0004
##    150        0.1120             nan     0.1000   -0.0011
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2731             nan     0.1000    0.0528
##      2        1.1796             nan     0.1000    0.0390
##      3        1.0329             nan     0.1000    0.0719
```

```
##      4        0.9220             nan     0.1000    0.0520
##      5        0.8683             nan     0.1000    0.0213
##      6        0.7985             nan     0.1000    0.0302
##      7        0.7104             nan     0.1000    0.0424
##      8        0.6358             nan     0.1000    0.0373
##      9        0.5989             nan     0.1000    0.0147
##     10        0.5428             nan     0.1000    0.0271
##     20        0.2595             nan     0.1000    0.0104
##     40        0.1033             nan     0.1000    0.0001
##     60        0.0669             nan     0.1000    0.0006
##     80        0.0438             nan     0.1000    0.0005
##    100        0.0322             nan     0.1000   -0.0002
##    120        0.0261             nan     0.1000   -0.0001
##    140        0.0194             nan     0.1000   -0.0001
##    150        0.0165             nan     0.1000   -0.0001
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3539             nan     0.1000    0.0154
##      2        1.3272             nan     0.1000    0.0115
##      3        1.3051             nan     0.1000    0.0097
##      4        1.2835             nan     0.1000    0.0088
##      5        1.2661             nan     0.1000    0.0071
##      6        1.2490             nan     0.1000    0.0059
##      7        1.2337             nan     0.1000    0.0044
##      8        1.2229             nan     0.1000    0.0013
##      9        1.2141             nan     0.1000   -0.0006
##     10        1.2030             nan     0.1000    0.0022
##     20        1.1416             nan     0.1000    0.0029
##     40        1.0702             nan     0.1000   -0.0015
##     60        1.0323             nan     0.1000   -0.0004
##     80        1.0069             nan     0.1000   -0.0053
##    100        0.9787             nan     0.1000   -0.0023
##    120        0.9597             nan     0.1000   -0.0026
##    140        0.9397             nan     0.1000   -0.0023
##    150        0.9311             nan     0.1000   -0.0011
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2951             nan     0.1000    0.0406
##      2        1.2121             nan     0.1000    0.0339
##      3        1.1778             nan     0.1000    0.0131
##      4        1.0954             nan     0.1000    0.0386
##      5        1.0538             nan     0.1000    0.0161
##      6        0.9830             nan     0.1000    0.0338
##      7        0.9289             nan     0.1000    0.0223
##      8        0.8704             nan     0.1000    0.0283
##      9        0.8325             nan     0.1000    0.0180
##     10        0.7839             nan     0.1000    0.0236
##     20        0.6163             nan     0.1000   -0.0021
##     40        0.4384             nan     0.1000   -0.0001
##     60        0.3764             nan     0.1000   -0.0018
##     80        0.2848             nan     0.1000   -0.0009
##    100        0.2170             nan     0.1000   -0.0016
```

```
##    120        0.1841             nan     0.1000   -0.0004
##    140        0.1608             nan     0.1000   -0.0005
##    150        0.1460             nan     0.1000   -0.0009
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2663             nan     0.1000    0.0547
##      2        1.1160             nan     0.1000    0.0761
##      3        1.0325             nan     0.1000    0.0399
##      4        0.9214             nan     0.1000    0.0551
##      5        0.8226             nan     0.1000    0.0494
##      6        0.7612             nan     0.1000    0.0278
##      7        0.7159             nan     0.1000    0.0212
##      8        0.6507             nan     0.1000    0.0314
##      9        0.6098             nan     0.1000    0.0185
##     10        0.5527             nan     0.1000    0.0279
##     20        0.2811             nan     0.1000    0.0035
##     40        0.1553             nan     0.1000   -0.0007
##     60        0.1123             nan     0.1000   -0.0009
##     80        0.0891             nan     0.1000   -0.0009
##    100        0.0698             nan     0.1000   -0.0007
##    120        0.0595             nan     0.1000   -0.0003
##    140        0.0443             nan     0.1000    0.0009
##    150        0.0384             nan     0.1000   -0.0003
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3519             nan     0.1000    0.0167
##      2        1.3199             nan     0.1000    0.0136
##      3        1.2876             nan     0.1000    0.0131
##      4        1.2569             nan     0.1000    0.0082
##      5        1.2359             nan     0.1000    0.0083
##      6        1.2204             nan     0.1000    0.0058
##      7        1.2083             nan     0.1000    0.0066
##      8        1.1980             nan     0.1000    0.0033
##      9        1.1847             nan     0.1000    0.0038
##     10        1.1766             nan     0.1000    0.0025
##     20        1.1266             nan     0.1000   -0.0070
##     40        1.0782             nan     0.1000   -0.0053
##     60        1.0272             nan     0.1000   -0.0012
##     80        1.0032             nan     0.1000   -0.0026
##    100        0.9713             nan     0.1000   -0.0044
##    120        0.9513             nan     0.1000   -0.0022
##    140        0.9266             nan     0.1000   -0.0020
##    150        0.9199             nan     0.1000   -0.0012
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2985             nan     0.1000    0.0440
##      2        1.2191             nan     0.1000    0.0368
##      3        1.1532             nan     0.1000    0.0313
##      4        1.0831             nan     0.1000    0.0316
##      5        1.0175             nan     0.1000    0.0286
##      6        0.9506             nan     0.1000    0.0333
##      7        0.9005             nan     0.1000    0.0238
```

```
##      8        0.8686             nan     0.1000    0.0129
##      9        0.8166             nan     0.1000    0.0248
##     10        0.7902             nan     0.1000    0.0104
##     20        0.5823             nan     0.1000    0.0007
##     40        0.4651             nan     0.1000   -0.0009
##     60        0.4138             nan     0.1000   -0.0007
##     80        0.3336             nan     0.1000    0.0044
##    100        0.2688             nan     0.1000   -0.0020
##    120        0.2221             nan     0.1000   -0.0010
##    140        0.1734             nan     0.1000   -0.0004
##    150        0.1640             nan     0.1000   -0.0011
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2105             nan     0.1000    0.0892
##      2        1.0937             nan     0.1000    0.0554
##      3        0.9982             nan     0.1000    0.0455
##      4        0.9201             nan     0.1000    0.0348
##      5        0.8556             nan     0.1000    0.0310
##      6        0.7615             nan     0.1000    0.0445
##      7        0.7230             nan     0.1000    0.0181
##      8        0.6524             nan     0.1000    0.0358
##      9        0.6075             nan     0.1000    0.0214
##     10        0.5494             nan     0.1000    0.0280
##     20        0.2620             nan     0.1000    0.0087
##     40        0.1381             nan     0.1000    0.0000
##     60        0.1029             nan     0.1000   -0.0004
##     80        0.0834             nan     0.1000   -0.0002
##    100        0.0629             nan     0.1000   -0.0006
##    120        0.0487             nan     0.1000   -0.0002
##    140        0.0396             nan     0.1000   -0.0002
##    150        0.0339             nan     0.1000   -0.0000
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3533             nan     0.1000    0.0181
##      2        1.3196             nan     0.1000    0.0145
##      3        1.2960             nan     0.1000    0.0111
##      4        1.2695             nan     0.1000    0.0111
##      5        1.2514             nan     0.1000    0.0052
##      6        1.2395             nan     0.1000    0.0044
##      7        1.2220             nan     0.1000    0.0065
##      8        1.2106             nan     0.1000    0.0048
##      9        1.1974             nan     0.1000    0.0033
##     10        1.1862             nan     0.1000    0.0031
##     20        1.1321             nan     0.1000   -0.0031
##     40        1.0673             nan     0.1000   -0.0022
##     60        1.0225             nan     0.1000   -0.0030
##     80        0.9930             nan     0.1000   -0.0064
##    100        0.9647             nan     0.1000   -0.0009
##    120        0.9449             nan     0.1000   -0.0018
##    140        0.9193             nan     0.1000   -0.0027
##    150        0.9068             nan     0.1000   -0.0013
##
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2663             nan     0.1000    0.0547
##      2        1.1833             nan     0.1000    0.0408
##      3        1.1114             nan     0.1000    0.0367
##      4        1.0585             nan     0.1000    0.0229
##      5        0.9853             nan     0.1000    0.0383
##      6        0.9274             nan     0.1000    0.0285
##      7        0.9037             nan     0.1000    0.0104
##      8        0.8494             nan     0.1000    0.0241
##      9        0.7968             nan     0.1000    0.0248
##     10        0.7710             nan     0.1000    0.0083
##     20        0.5931             nan     0.1000    0.0055
##     40        0.4628             nan     0.1000    0.0006
##     60        0.3454             nan     0.1000    0.0004
##     80        0.2582             nan     0.1000   -0.0005
##    100        0.1920             nan     0.1000   -0.0006
##    120        0.1675             nan     0.1000   -0.0010
##    140        0.1295             nan     0.1000    0.0007
##    150        0.1189             nan     0.1000    0.0002
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2165             nan     0.1000    0.0833
##      2        1.1405             nan     0.1000    0.0342
##      3        1.0471             nan     0.1000    0.0415
##      4        0.9261             nan     0.1000    0.0592
##      5        0.8543             nan     0.1000    0.0304
##      6        0.7629             nan     0.1000    0.0449
##      7        0.6850             nan     0.1000    0.0393
##      8        0.6170             nan     0.1000    0.0332
##      9        0.5570             nan     0.1000    0.0285
##     10        0.5063             nan     0.1000    0.0247
##     20        0.2631             nan     0.1000    0.0096
##     40        0.1302             nan     0.1000   -0.0005
##     60        0.0995             nan     0.1000    0.0003
##     80        0.0703             nan     0.1000   -0.0005
##    100        0.0529             nan     0.1000   -0.0008
##    120        0.0404             nan     0.1000   -0.0002
##    140        0.0314             nan     0.1000    0.0002
##    150        0.0293             nan     0.1000   -0.0002
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3554             nan     0.1000    0.0161
##      2        1.3251             nan     0.1000    0.0116
##      3        1.3094             nan     0.1000    0.0047
##      4        1.2825             nan     0.1000    0.0033
##      5        1.2652             nan     0.1000    0.0070
##      6        1.2549             nan     0.1000    0.0015
##      7        1.2338             nan     0.1000    0.0082
##      8        1.2217             nan     0.1000    0.0067
##      9        1.2157             nan     0.1000   -0.0003
##     10        1.2039             nan     0.1000    0.0024
##     20        1.1335             nan     0.1000    0.0014
```

```
##     40        1.0678             nan     0.1000   -0.0011
##     60        1.0319             nan     0.1000   -0.0002
##     80        0.9962             nan     0.1000   -0.0034
##    100        0.9724             nan     0.1000   -0.0012
##    120        0.9456             nan     0.1000   -0.0045
##    140        0.9231             nan     0.1000   -0.0008
##    150        0.9179             nan     0.1000   -0.0026
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2862             nan     0.1000    0.0480
##      2        1.2128             nan     0.1000    0.0334
##      3        1.1442             nan     0.1000    0.0327
##      4        1.0929             nan     0.1000    0.0247
##      5        1.0390             nan     0.1000    0.0289
##      6        1.0000             nan     0.1000    0.0188
##      7        0.9630             nan     0.1000    0.0168
##      8        0.9177             nan     0.1000    0.0192
##      9        0.8574             nan     0.1000    0.0289
##     10        0.8144             nan     0.1000    0.0197
##     20        0.5949             nan     0.1000   -0.0005
##     40        0.4647             nan     0.1000    0.0084
##     60        0.3544             nan     0.1000   -0.0007
##     80        0.2892             nan     0.1000    0.0001
##    100        0.2296             nan     0.1000    0.0005
##    120        0.1639             nan     0.1000   -0.0017
##    140        0.1344             nan     0.1000   -0.0007
##    150        0.1224             nan     0.1000   -0.0005
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2835             nan     0.1000    0.0474
##      2        1.1702             nan     0.1000    0.0514
##      3        1.0360             nan     0.1000    0.0657
##      4        0.9537             nan     0.1000    0.0377
##      5        0.8822             nan     0.1000    0.0344
##      6        0.8260             nan     0.1000    0.0247
##      7        0.8054             nan     0.1000    0.0043
##      8        0.7506             nan     0.1000    0.0241
##      9        0.6953             nan     0.1000    0.0287
##     10        0.6232             nan     0.1000    0.0355
##     20        0.2917             nan     0.1000    0.0063
##     40        0.1268             nan     0.1000   -0.0011
##     60        0.0898             nan     0.1000   -0.0007
##     80        0.0735             nan     0.1000   -0.0007
##    100        0.0577             nan     0.1000   -0.0003
##    120        0.0435             nan     0.1000    0.0014
##    140        0.0342             nan     0.1000   -0.0001
##    150        0.0323             nan     0.1000   -0.0004
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3515             nan     0.1000    0.0143
##      2        1.3225             nan     0.1000    0.0145
##      3        1.3060             nan     0.1000    0.0110
```

```
##      4        1.2858             nan     0.1000    0.0053
##      5        1.2649             nan     0.1000    0.0044
##      6        1.2506             nan     0.1000    0.0060
##      7        1.2338             nan     0.1000    0.0058
##      8        1.2236             nan     0.1000    0.0037
##      9        1.2130             nan     0.1000    0.0049
##     10        1.2088             nan     0.1000   -0.0035
##     20        1.1515             nan     0.1000   -0.0029
##     40        1.0930             nan     0.1000   -0.0025
##     60        1.0591             nan     0.1000   -0.0026
##     80        1.0306             nan     0.1000   -0.0017
##    100        1.0109             nan     0.1000   -0.0021
##    120        0.9929             nan     0.1000   -0.0043
##    140        0.9641             nan     0.1000   -0.0012
##    150        0.9541             nan     0.1000   -0.0021
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2783             nan     0.1000    0.0506
##      2        1.1842             nan     0.1000    0.0446
##      3        1.1201             nan     0.1000    0.0235
##      4        1.0644             nan     0.1000    0.0242
##      5        0.9842             nan     0.1000    0.0412
##      6        0.9231             nan     0.1000    0.0282
##      7        0.9061             nan     0.1000    0.0050
##      8        0.8839             nan     0.1000    0.0115
##      9        0.8320             nan     0.1000    0.0222
##     10        0.8203             nan     0.1000    0.0045
##     20        0.6347             nan     0.1000    0.0223
##     40        0.5379             nan     0.1000   -0.0015
##     60        0.4212             nan     0.1000   -0.0008
##     80        0.3151             nan     0.1000    0.0001
##    100        0.2510             nan     0.1000   -0.0012
##    120        0.2000             nan     0.1000    0.0013
##    140        0.1468             nan     0.1000    0.0021
##    150        0.1223             nan     0.1000   -0.0005
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3321             nan     0.1000    0.0151
##      2        1.1716             nan     0.1000    0.0777
##      3        1.0262             nan     0.1000    0.0722
##      4        0.9617             nan     0.1000    0.0245
##      5        0.8523             nan     0.1000    0.0554
##      6        0.7961             nan     0.1000    0.0309
##      7        0.7104             nan     0.1000    0.0430
##      8        0.6331             nan     0.1000    0.0370
##      9        0.5697             nan     0.1000    0.0321
##     10        0.5218             nan     0.1000    0.0229
##     20        0.2631             nan     0.1000    0.0031
##     40        0.0963             nan     0.1000   -0.0003
##     60        0.0623             nan     0.1000    0.0004
##     80        0.0397             nan     0.1000   -0.0001
##    100        0.0287             nan     0.1000    0.0001
```

```
##    120        0.0219             nan     0.1000   -0.0003
##    140        0.0176             nan     0.1000    0.0003
##    150        0.0158             nan     0.1000   -0.0001
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3510             nan     0.1000    0.0164
##      2        1.3199             nan     0.1000    0.0155
##      3        1.3048             nan     0.1000    0.0044
##      4        1.2789             nan     0.1000    0.0111
##      5        1.2602             nan     0.1000    0.0084
##      6        1.2452             nan     0.1000    0.0082
##      7        1.2326             nan     0.1000    0.0053
##      8        1.2158             nan     0.1000    0.0052
##      9        1.2114             nan     0.1000   -0.0006
##     10        1.2016             nan     0.1000    0.0038
##     20        1.1399             nan     0.1000   -0.0034
##     40        1.0943             nan     0.1000   -0.0038
##     60        1.0531             nan     0.1000   -0.0018
##     80        1.0243             nan     0.1000   -0.0026
##    100        1.0018             nan     0.1000   -0.0036
##    120        0.9730             nan     0.1000   -0.0008
##    140        0.9511             nan     0.1000   -0.0016
##    150        0.9423             nan     0.1000   -0.0051
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2926             nan     0.1000    0.0406
##      2        1.1940             nan     0.1000    0.0411
##      3        1.1254             nan     0.1000    0.0322
##      4        1.0547             nan     0.1000    0.0315
##      5        0.9893             nan     0.1000    0.0299
##      6        0.9453             nan     0.1000    0.0204
##      7        0.8863             nan     0.1000    0.0278
##      8        0.8487             nan     0.1000    0.0189
##      9        0.8064             nan     0.1000    0.0198
##     10        0.7643             nan     0.1000    0.0195
##     20        0.5916             nan     0.1000    0.0097
##     40        0.4255             nan     0.1000    0.0029
##     60        0.3512             nan     0.1000   -0.0011
##     80        0.3044             nan     0.1000   -0.0010
##    100        0.2415             nan     0.1000   -0.0005
##    120        0.2136             nan     0.1000   -0.0016
##    140        0.1718             nan     0.1000   -0.0002
##    150        0.1588             nan     0.1000    0.0020
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2078             nan     0.1000    0.0864
##      2        1.0797             nan     0.1000    0.0624
##      3        0.9563             nan     0.1000    0.0605
##      4        0.8547             nan     0.1000    0.0504
##      5        0.7947             nan     0.1000    0.0304
##      6        0.7243             nan     0.1000    0.0354
##      7        0.6772             nan     0.1000    0.0209
```

```
##      8        0.6293             nan     0.1000    0.0240
##      9        0.5716             nan     0.1000    0.0277
##     10        0.5182             nan     0.1000    0.0244
##     20        0.2589             nan     0.1000    0.0087
##     40        0.1297             nan     0.1000    0.0002
##     60        0.0956             nan     0.1000   -0.0004
##     80        0.0765             nan     0.1000   -0.0004
##    100        0.0640             nan     0.1000   -0.0003
##    120        0.0501             nan     0.1000   -0.0004
##    140        0.0419             nan     0.1000   -0.0008
##    150        0.0373             nan     0.1000   -0.0004
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3475             nan     0.1000    0.0179
##      2        1.3175             nan     0.1000    0.0128
##      3        1.2842             nan     0.1000    0.0124
##      4        1.2637             nan     0.1000    0.0108
##      5        1.2463             nan     0.1000    0.0075
##      6        1.2243             nan     0.1000    0.0057
##      7        1.2111             nan     0.1000    0.0060
##      8        1.1992             nan     0.1000    0.0062
##      9        1.1875             nan     0.1000    0.0036
##     10        1.1781             nan     0.1000    0.0021
##     20        1.1086             nan     0.1000   -0.0018
##     40        1.0456             nan     0.1000   -0.0013
##     60        1.0124             nan     0.1000   -0.0024
##     80        0.9821             nan     0.1000   -0.0036
##    100        0.9524             nan     0.1000   -0.0020
##    120        0.9287             nan     0.1000   -0.0044
##    140        0.9075             nan     0.1000   -0.0034
##    150        0.9045             nan     0.1000   -0.0003
## 
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2775             nan     0.1000    0.0583
##      2        1.1865             nan     0.1000    0.0385
##      3        1.1085             nan     0.1000    0.0370
##      4        1.0617             nan     0.1000    0.0200
##      5        1.0070             nan     0.1000    0.0258
##      6        0.9678             nan     0.1000    0.0138
##      7        0.9335             nan     0.1000    0.0160
##      8        0.8985             nan     0.1000    0.0145
##      9        0.8576             nan     0.1000    0.0152
##     10        0.8420             nan     0.1000    0.0049
##     20        0.6234             nan     0.1000   -0.0001
##     40        0.4655             nan     0.1000    0.0021
##     60        0.3536             nan     0.1000    0.0007
##     80        0.2844             nan     0.1000   -0.0012
##    100        0.2451             nan     0.1000   -0.0003
##    120        0.2098             nan     0.1000   -0.0010
##    140        0.1717             nan     0.1000   -0.0007
##    150        0.1674             nan     0.1000   -0.0009
## 
```

```
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2646             nan     0.1000    0.0614
##      2        1.2187             nan     0.1000    0.0174
##      3        1.0767             nan     0.1000    0.0728
##      4        1.0486             nan     0.1000    0.0122
##      5        0.9441             nan     0.1000    0.0509
##      6        0.8712             nan     0.1000    0.0343
##      7        0.8386             nan     0.1000    0.0144
##      8        0.7800             nan     0.1000    0.0257
##      9        0.7374             nan     0.1000    0.0186
##     10        0.6923             nan     0.1000    0.0204
##     20        0.3854             nan     0.1000    0.0176
##     40        0.1881             nan     0.1000    0.0059
##     60        0.1368             nan     0.1000    0.0011
##     80        0.1115             nan     0.1000   -0.0002
##    100        0.0886             nan     0.1000   -0.0010
##    120        0.0703             nan     0.1000   -0.0002
##    140        0.0524             nan     0.1000   -0.0001
##    150        0.0473             nan     0.1000   -0.0006
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3540             nan     0.1000    0.0108
##      2        1.3228             nan     0.1000    0.0121
##      3        1.2968             nan     0.1000    0.0111
##      4        1.2808             nan     0.1000    0.0096
##      5        1.2635             nan     0.1000    0.0070
##      6        1.2617             nan     0.1000   -0.0023
##      7        1.2472             nan     0.1000    0.0052
##      8        1.2317             nan     0.1000    0.0072
##      9        1.2241             nan     0.1000   -0.0008
##     10        1.2115             nan     0.1000    0.0025
##     20        1.1355             nan     0.1000   -0.0017
##     40        1.0758             nan     0.1000   -0.0034
##     60        1.0409             nan     0.1000   -0.0043
##     80        1.0110             nan     0.1000   -0.0020
##    100        0.9871             nan     0.1000   -0.0008
##    120        0.9617             nan     0.1000   -0.0051
##    140        0.9384             nan     0.1000   -0.0019
##    150        0.9329             nan     0.1000   -0.0050
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2972             nan     0.1000    0.0405
##      2        1.2183             nan     0.1000    0.0378
##      3        1.1504             nan     0.1000    0.0340
##      4        1.0883             nan     0.1000    0.0246
##      5        1.0674             nan     0.1000    0.0096
##      6        1.0445             nan     0.1000    0.0076
##      7        0.9990             nan     0.1000    0.0199
##      8        0.9224             nan     0.1000    0.0338
##      9        0.9044             nan     0.1000    0.0045
##     10        0.8782             nan     0.1000    0.0088
##     20        0.6760             nan     0.1000   -0.0009
```

```
##     40        0.5285             nan     0.1000    0.0001
##     60        0.4527             nan     0.1000   -0.0016
##     80        0.3832             nan     0.1000   -0.0011
##    100        0.3165             nan     0.1000   -0.0008
##    120        0.2496             nan     0.1000    0.0040
##    140        0.2136             nan     0.1000    0.0003
##    150        0.1925             nan     0.1000   -0.0007
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.2326             nan     0.1000    0.0748
##      2        1.1773             nan     0.1000    0.0265
##      3        1.0755             nan     0.1000    0.0483
##      4        1.0347             nan     0.1000    0.0162
##      5        0.9491             nan     0.1000    0.0416
##      6        0.9037             nan     0.1000    0.0191
##      7        0.8115             nan     0.1000    0.0442
##      8        0.7350             nan     0.1000    0.0377
##      9        0.7111             nan     0.1000    0.0094
##     10        0.6389             nan     0.1000    0.0368
##     20        0.4444             nan     0.1000    0.0010
##     40        0.2072             nan     0.1000   -0.0002
##     60        0.1496             nan     0.1000   -0.0007
##     80        0.1227             nan     0.1000   -0.0010
##    100        0.1009             nan     0.1000    0.0004
##    120        0.0758             nan     0.1000   -0.0005
##    140        0.0601             nan     0.1000   -0.0002
##    150        0.0541             nan     0.1000   -0.0005
##
## Iter   TrainDeviance   ValidDeviance   StepSize   Improve
##      1        1.3345             nan     0.1000    0.0165
##      2        1.2072             nan     0.1000    0.0638
##      3        1.1068             nan     0.1000    0.0478
##      4        0.9793             nan     0.1000    0.0644
##      5        0.9074             nan     0.1000    0.0343
##      6        0.8415             nan     0.1000    0.0262
##      7        0.7672             nan     0.1000    0.0359
##      8        0.6904             nan     0.1000    0.0393
##      9        0.6456             nan     0.1000    0.0225
##     10        0.5947             nan     0.1000    0.0253
##     20        0.3133             nan     0.1000    0.0073
##     40        0.1374             nan     0.1000    0.0003
##     50        0.1235             nan     0.1000   -0.0015
```

```
stacking_results <- resamples(stacked_models)

stacking_summary<- summary(stacking_results)
stacking_summary
```

```
##
## Call:
## summary.resamples(object = stacking_results)
##
## Models: glm, knn, svmPoly, svmLinear, wsrf, gbm
## Number of resamples: 10
##
## Accuracy
##               Min.   1st Qu.    Median      Mean   3rd Qu.     Max. NA's
## glm       0.609375 0.6757812 0.7031250 0.7093750 0.7500000 0.812500    0
## knn       0.640625 0.6914062 0.7421875 0.7375000 0.7656250 0.828125    0
## svmPoly   0.765625 0.7851562 0.8125000 0.8031250 0.8125000 0.843750    0
## svmLinear 0.765625 0.7851562 0.7968750 0.8015625 0.8125000 0.843750    0
## wsrf      0.906250 0.9375000 0.9453125 0.9531250 0.9648438 1.000000    0
## gbm       0.953125 0.9570312 0.9843750 0.9765625 0.9843750 1.000000    0
##
## Kappa
##              Min.   1st Qu.   Median     Mean   3rd Qu.    Max. NA's
## glm       0.21875 0.3515625 0.406250 0.418750 0.5000000 0.62500    0
## knn       0.28125 0.3828125 0.484375 0.475000 0.5312500 0.65625    0
## svmPoly   0.53125 0.5703125 0.625000 0.606250 0.6250000 0.68750    0
## svmLinear 0.53125 0.5703125 0.593750 0.603125 0.6250000 0.68750    0
## wsrf      0.81250 0.8750000 0.890625 0.906250 0.9296875 1.00000    0
## gbm       0.90625 0.9140625 0.968750 0.953125 0.9687500 1.00000    0
```

Plot results

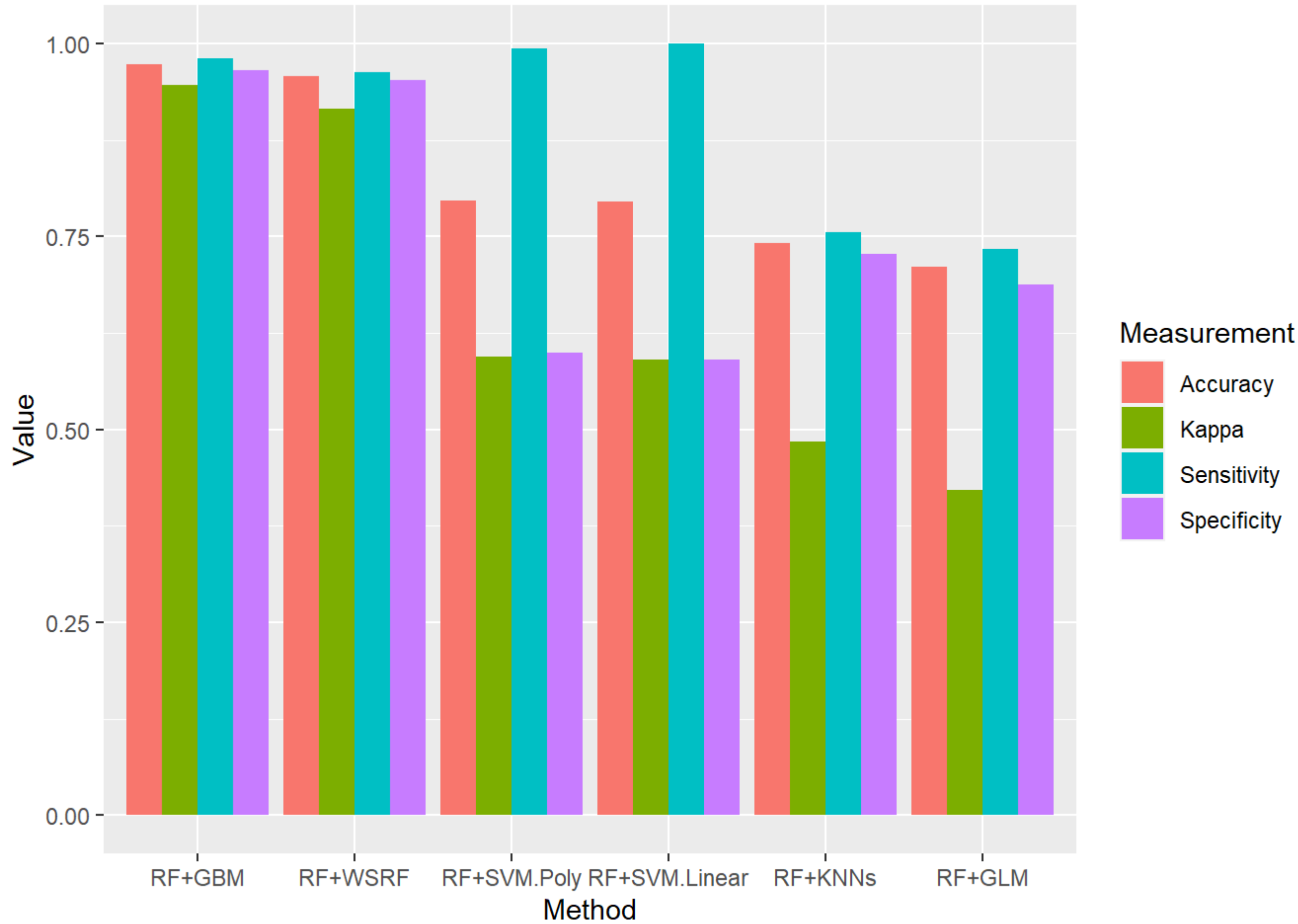
```
glm_cm<- confusionMatrix(stacked_models$glm$pred$pred, stacked_models$glm$pred$obs)
knn_cm<- confusionMatrix(stacked_models$knn$pred$pred, stacked_models$knn$pred$obs)
svmPoly_cm<- confusionMatrix(stacked_models$svmPoly$pred$pred, stacked_models$svmPoly$pred$obs)
svmLinear_cm<- confusionMatrix(stacked_models$svmLinear$pred$pred, stacked_models$svmLinear$pred
$obs)
wsrf_cm<- confusionMatrix(stacked_models$wsrf$pred$pred, stacked_models$wsrf$pred$obs)
gbm_cm<- confusionMatrix(stacked_models$gbm$pred$pred, stacked_models$gbm$pred$obs)

data <- data.frame(matrix(c(0.7109, 0.7422, 0.7969, 0.7953, 0.9578, 0.9734,
                            0.7344, 0.7562, 0.9938, 1.0000, 0.9625, 0.9812,
                            0.6875, 0.7281, 0.6000, 0.5906, 0.9531, 0.9656,
                            0.4219, 0.4844, 0.5938, 0.5906, 0.9156, 0.9469),6,4))
row <- c("RF+GLM", "RF+KNNs", "RF+SVM.Poly", "RF+SVM.Linear", "RF+WSRF", "RF+GBM")
col <- c("Accuracy", "Sensitivity", "Specificity", "Kappa")
colnames(data) <- col
data$Method <- row
rownames(data) <- c(1:6)
data1<- data[,c(5,1,2,3,4)]

#write.csv(data, "ensemble_result.csv")
#plotting
library(ggplot2)

data2 <- tidyr::gather(data1, key="Measurement", value="Value", 2:5)

# Grouped
ggplot(data2, aes(fill=Measurement, y=Value, x=reorder(Method, -Value))) +
  geom_bar(position="dodge", stat="identity")+
  xlab("Method")
```



NLP in Transcription

document summarize

```
# write summerizer function
library(textmineR)
```

```
## Warning: package 'textmineR' was built under R version 4.2.2
```

```
## Loading required package: Matrix
```

```
## Warning: package 'Matrix' was built under R version 4.2.2
```

```
##
## Attaching package: 'Matrix'
```

```
## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack
```

```
##
## Attaching package: 'textmineR'
```

```
## The following object is masked from 'package:Matrix':
##
##     update
```

```
## The following object is masked from 'package:stats':
##
##     update
```

```
library(igraph)
```

```
## Warning: package 'igraph' was built under R version 4.2.2
```

```
##
## Attaching package: 'igraph'
```

```
## The following object is masked from 'package:wsrf':
##
##     strength
```

```
## The following object is masked from 'package:class':
##
##     knn
```

```
## The following objects are masked from 'package:dplyr':
##
##     as_data_frame, groups, union
```

```
## The following objects are masked from 'package:purrr':
##
##     compose, simplify
```

```
## The following object is masked from 'package:tidyr':
##
##     crossing
```

```
## The following object is masked from 'package:tibble':
##
##     as_data_frame
```

```
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
```

```
## The following object is masked from 'package:base':
##
##     union
```

```
tcm <- CreateTcm(doc_vec = MU3D_Video_Level_Data$Transcription,
                 skipgram_window = 10,
                 verbose = FALSE,
                 cpus = 2)
```

```
## as(<dgTMatrix>, "dgCMatrix") is deprecated since Matrix 1.5-0; do as(., "CsparseMatrix") inst
ead
```

```
# use LDA to get embeddings into probability space
# This will take considerably longer as the TCM matrix has many more rows
# than a DTM
embeddings <- FitLdaModel(dtm = tcm,
                          k = 50,
                          iterations = 200,
                          burnin = 180,
                          alpha = 0.1,
                          beta = 0.05,
                          optimize_alpha = TRUE,
                          calc_likelihood = FALSE,
                          calc_coherence = FALSE,
                          calc_r2 = FALSE,
                          cpus = 2)

summarizer <- function(doc, gamma) {

  # recursive fanciness to handle multiple docs at once
  if (length(doc) > 1 )
    # use a try statement to catch any weirdness that may arise
    return(sapply(doc, function(d) try(summarizer(d, gamma))))

  # parse it into sentences
  sent <- stringi::stri_split_boundaries(doc, type = "sentence")[[ 1 ]]

  names(sent) <- seq_along(sent) # so we know index and order

  # embed the sentences in the model
  e <- CreateDtm(sent, ngram_window = c(1,1), verbose = FALSE, cpus = 2)

  # remove any documents with 2 or fewer words
  e <- e[ rowSums(e) > 2 , ]

  vocab <- intersect(colnames(e), colnames(gamma))

  e <- e / rowSums(e)

  e <- e[ , vocab ] %*% t(gamma[ , vocab ])

  e <- as.matrix(e)

  # get the pairwise distances between each embedded sentence
  e_dist <- CalcHellingerDist(e)

  # turn into a similarity matrix
  g <- (1 - e_dist) * 100

  # we don't need sentences connected to themselves
  diag(g) <- 0

  # turn into a nearest-neighbor graph
  g <- apply(g, 1, function(x){
```

```
    x[ x < sort(x, decreasing = TRUE)[ 3 ] ] <- 0
    x
  })

  # by taking pointwise max, we'll make the matrix symmetric again
  g <- pmax(g, t(g))

  g <- graph.adjacency(g, mode = "undirected", weighted = TRUE)

  # calculate eigenvector centrality
  ev <- evcent(g)

  # format the result
  result <- sent[ names(ev$vector)[ order(ev$vector, decreasing = TRUE)[ 1:3 ] ] ]

  result <- result[ order(as.numeric(names(result))) ]

  paste(result, collapse = " ")
}
```

Summarize text

```
docs <- MU3D_Video_Level_Data$Transcription[1]
sums <- summarizer(docs, gamma = embeddings$gamma)
docs
```

```
## [1] "My best friend is a really nice person. Um. She’s always kind to everyone. She continues
to just be herself around everyone. Um. She has taught me so much throughout, like I’ve known he
r maybe a year and a half and she’s taught me so much throughout that time. Um. I just love her
so much because she’s influenced my life in so many ways. And made me a better person because sh
e’s such a nice pershon, person. And I wish uh more people in the world were like her just becau
se um people need to realize that being negative all the time isn’t helping at all. So, she’s aw
esome."
```

```
sums
```

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## [1] "She has taught me so much throughout, like I’ve known her maybe a year and a half and sh
e’s taught me so much throughout that time.  And made me a better person because she’s such a ni
ce pershon, person.  And I wish uh more people in the world were like her just because um people
need to realize that being negative all the time isn’t helping at all. "
```