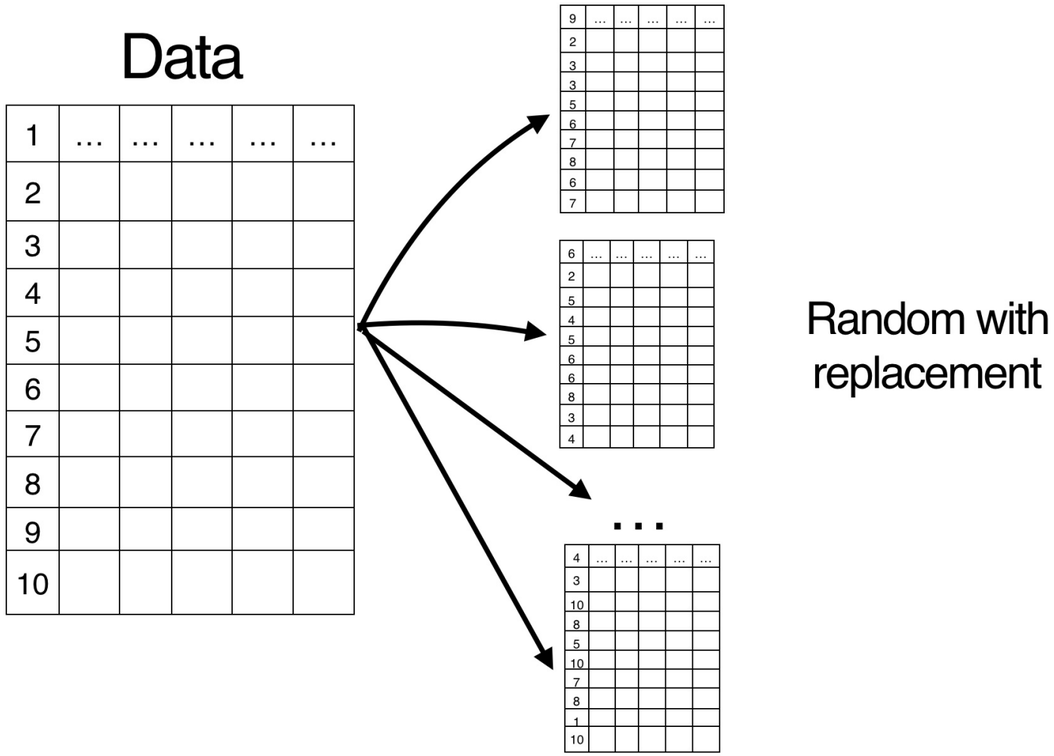
MACHINE LEARNING WITH TREE-BASED MODELS IN R

Introduction to bagged trees

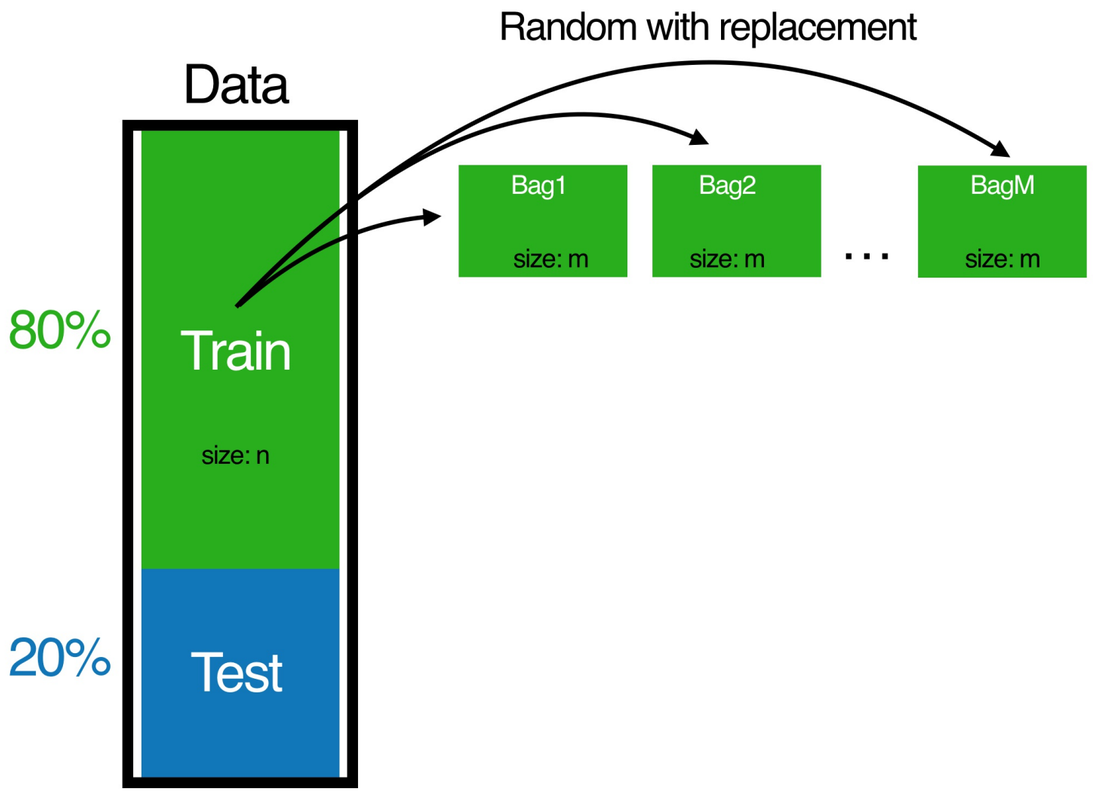
Gabriela de Queiroz
Instructor

Bagging

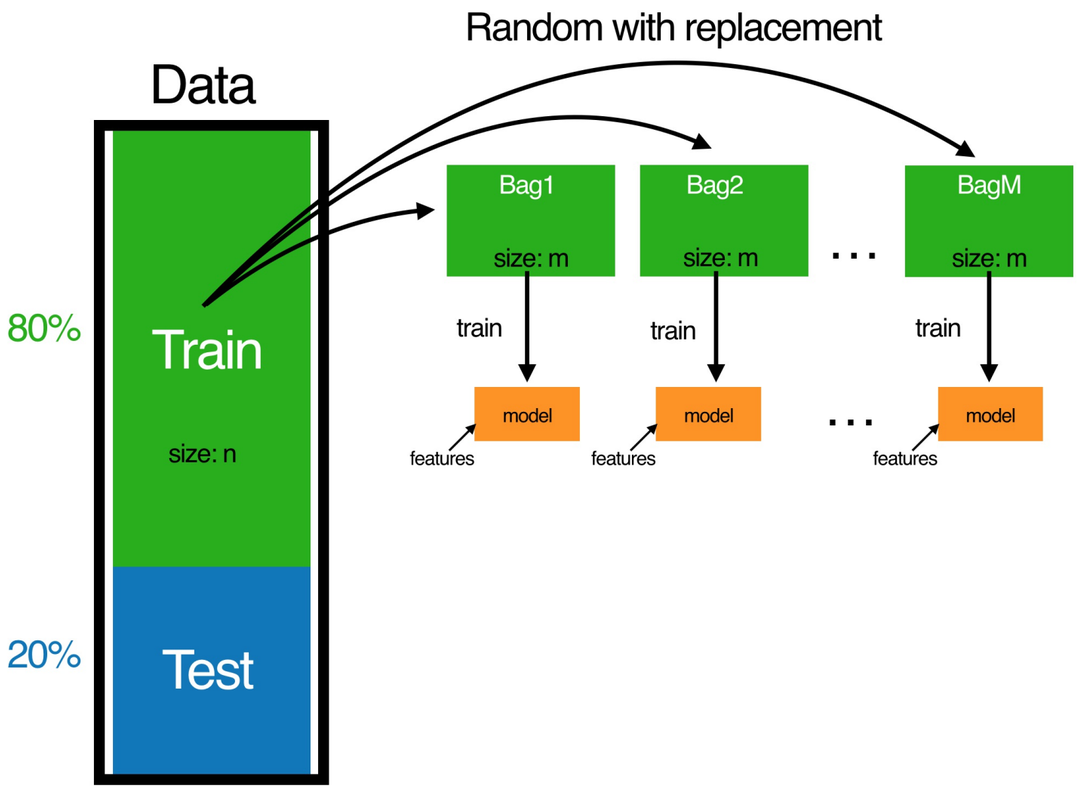
Bootstrap **AGG**regat**ING**



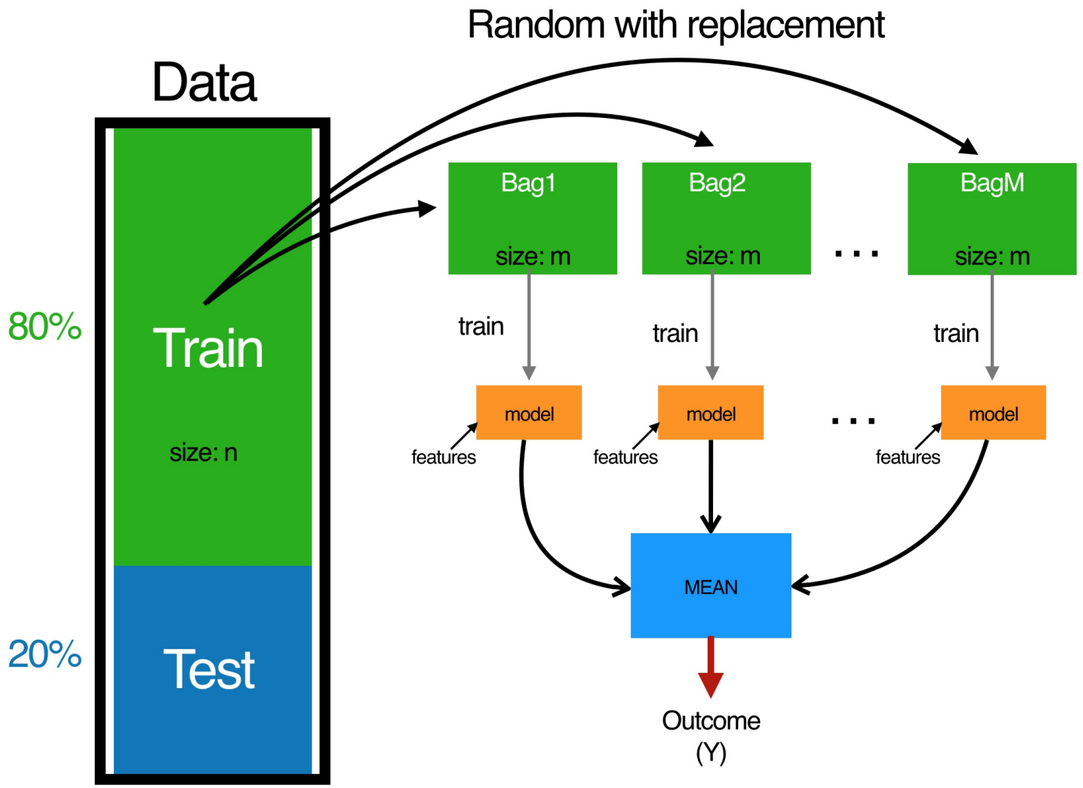
Step 1


Random with replacement
Data
Bag1
size: m
Bag2
size: m
BagM
size: m
80%
Train
size: n
20%
Test

Step 2


Random with replacement
Data
80%
Train
size: n
20%
Test
Bag1
size: m
Bag2
size: m
BagM
size: m
train
train
train
model
model
model
features
features
features

Bagging


Random with replacement
Data
80%
Train
size: n
20%
Test
Bag1
size: m
Bag2
size: m
BagM
size: m
train
train
train
model
model
model
features
features
features
MEAN
Outcome
(Y)

Bagging in R

```
> library(ipred)
> bagging(formula = response ~ ., data = dat)
```

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Let's practice!

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Evaluating the performance of bagged tree models

Gabriela de Queiroz
Instructor

Generate Predictions

```
> class_predictions <- predict(object = rest_model_bag,   # model object
                               newdata = restaurant_test,  # test dataset
                               type = "class")  # return classification labels
```

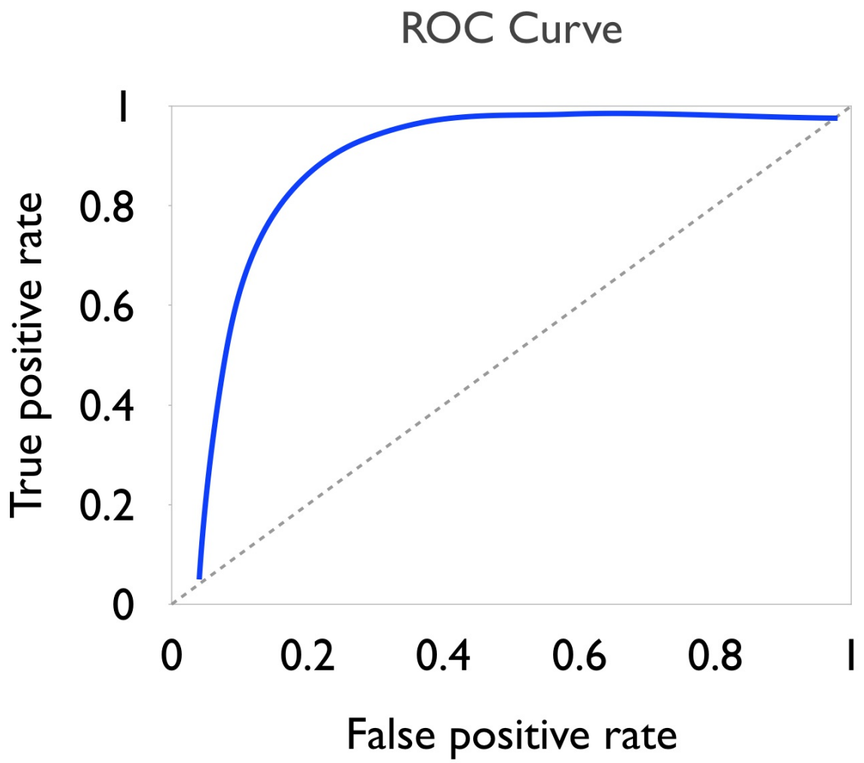
```
> print(class_predictions)
[1] Yes Yes Yes Yes No  No  Yes No  Yes Yes Yes Yes No  No  No  Yes No  Yes Yes N
Levels: No Yes
```

Confusion Matrix

```
> confusionMatrix(data = class_predictions,               # predicted classes
                  reference = restaurant_test$will_wait) # actual classes
```

```
Confusion Matrix and Statistics

          Reference
Prediction No Yes
       No   5   3
       Yes  1  12

               Accuracy : 0.8095
                 95% CI : (0.5809, 0.9455)
    No Information Rate : 0.7143
    P-Value [Acc > NIR] : 0.2402

                  Kappa : 0.5758
 Mcnemar's Test P-Value : 0.6171

            Sensitivity : 0.8333
            Specificity : 0.8000
         Pos Pred Value : 0.6250
         Neg Pred Value : 0.9231
         ...
```

ROC Curve


ROC Curve
True positive rate
False positive rate
0
0.2
0.4
0.6
0.8
1

AUC

```
> library(Metrics)
> auc(actual, predicted)
[1] .76765
```

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Cross-validation

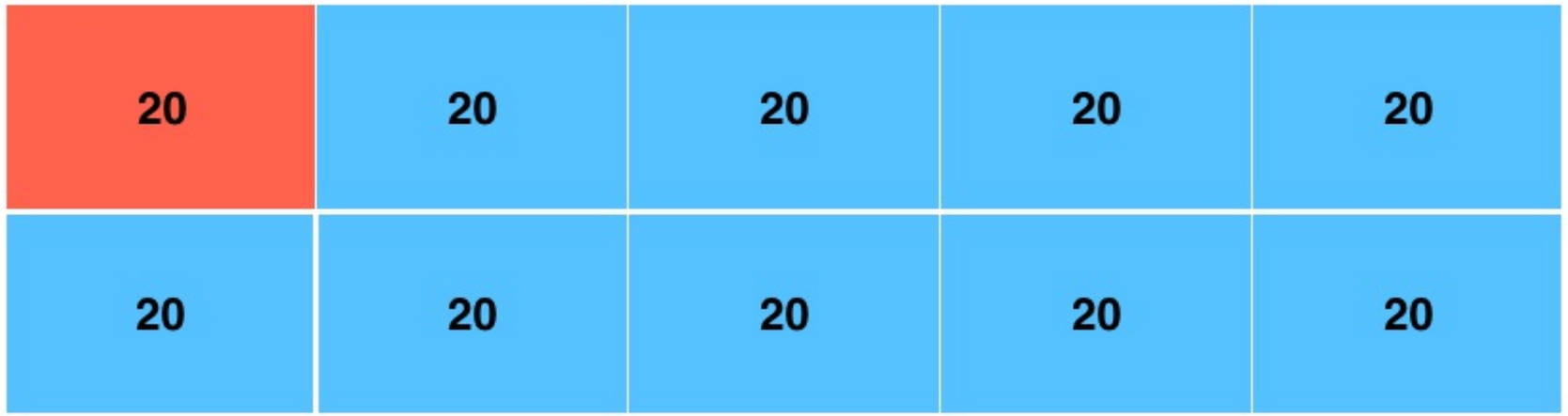
Gabriela de Queiroz
Instructor

K-fold Cross-validation

- dataset size = 200 rows
- k = 10 (number of cross validation folds)

20	20	20	20	20
20	20	20	20	20

K-fold Cross-validation



- 10 estimates of test set AUC
- the average is the cross-validated estimate of AUC

Using caret for cross-validating models

```
> library(caret)
```

- train()
- trainControl()

Training configuration

```
# Specify the training configuration
ctrl <- trainControl(method = "cv",                     # Cross-validation
                     number = 5,                        # 5 folds
                     classProbs = TRUE,                 # For AUC
                     summaryFunction = twoClassSummary)  # For AUC
```

Training configuration

```
set.seed(1)  #for reproducibility
credit_model <- train(default ~ .,
                      data = credit_train,
                      method = "treebag",
                      metric = "ROC",
                      trControl = ctrl)
```

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