Random forests

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Random forests

1. Bootstrap samples

2. At each split, bootstrap variables
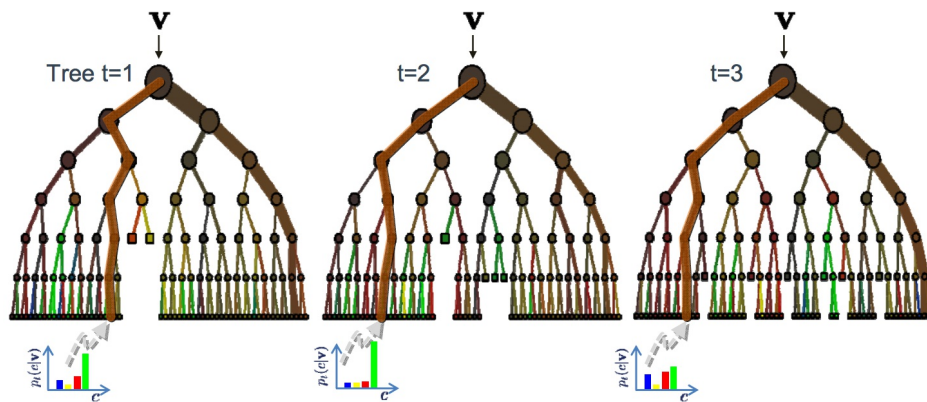
3. Grow multiple trees and vote

Pros:

1. Accuracy

Cons:
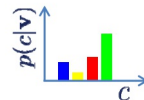
1. Speed

2. Interpretability

3. Overfitting

Random forests

The ensemble model

Forest output probability $p(c|\mathbf{v}) = \dfrac{1}{T}\displaystyle\sum_t^T p_t(c|\mathbf{v})$

http://www.robots.ox.ac.uk/~az/lectures/ml/lect5.pdf

Iris data

```
data(iris); library(ggplot2)
inTrain <- createDataPartition(y=iris$Species,
                                p=0.7, list=FALSE)
training <- iris[inTrain,]
testing <- iris[-inTrain,]
```

Random forests

```r
library(caret)
modFit <- train(Species~ .,data=training,method="rf",prox=TRUE)
modFit
```

```
105 samples
  4 predictors
  3 classes: 'setosa', 'versicolor', 'virginica'

No pre-processing
Resampling: Bootstrap (25 reps)

Summary of sample sizes: 105, 105, 105, 105, 105, 105, ...

Resampling results across tuning parameters:

  mtry  Accuracy  Kappa  Accuracy SD  Kappa SD
  2     0.9       0.9    0.03         0.04
  3     0.9       0.9    0.03         0.05
  4     0.9       0.9    0.03         0.05
```

Getting a single tree

```
getTree(modFit$finalModel,k=2)
```

	left daughter	right daughter	split var	split point	status	prediction
1	2	3	4	0.70	1	0
2	0	0	0	0.00	-1	1
3	4	5	4	1.70	1	0
4	6	7	3	4.95	1	0
5	8	9	3	4.85	1	0
6	0	0	0	0.00	-1	2
7	10	11	4	1.55	1	0
8	12	13	1	5.95	1	0
9	0	0	0	0.00	-1	3
10	0	0	0	0.00	-1	3
11	0	0	0	0.00	-1	2
12	0	0	0	0.00	-1	2
13	0	0	0	0.00	-1	3

Class "centers"

```
irisP <- classCenter(training[,c(3,4)], training$Species, modFit$finalModel$prox)
irisP <- as.data.frame(irisP); irisP$Species <- rownames(irisP)
p <- qplot(Petal.Width, Petal.Length, col=Species,data=training)
p + geom_point(aes(x=Petal.Width,y=Petal.Length,col=Species),size=5,shape=4,data=irisP)
```
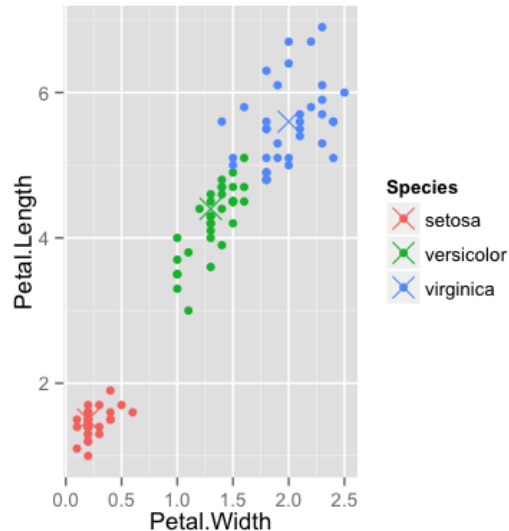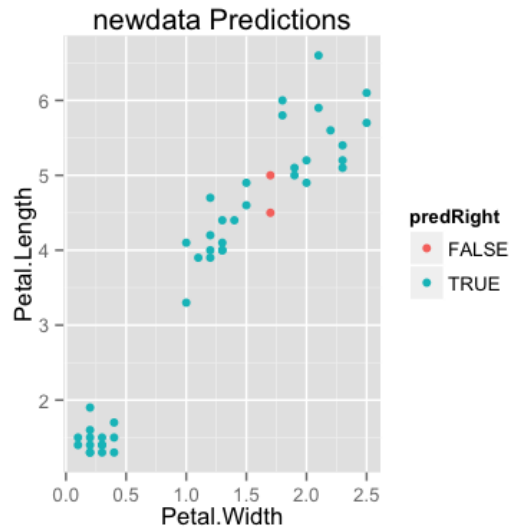
Predicting new values

```
pred <- predict(modFit,testing); testing$predRight <- pred==testing$Species
table(pred,testing$Species)
```

```
pred          setosa versicolor virginica
  setosa          15          0         0
  versicolor       0         14         1
  virginica        0          1        14
```

Predicting new values

```
qplot(Petal.Width,Petal.Length,colour=predRight,data=testing,main="newdata Predictions")
```

Notes and further resources

Notes:

· Random forests are usually one of the two top performing algorithms along with boosting in prediction contests.

· Random forests are difficult to interpret but often very accurate.

· Care should be taken to avoid overfitting (see rfcv funtion)

Further resources:

· Random forests
· Random forest Wikipedia
· Elements of Statistical Learning