Decision Tree example

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R Markdown

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When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
library(caTools)
library(rpart)
```

```
set.seed(1)
split <- sample.split(iris,SplitRatio = 0.7)
split
```

```
## [1]  TRUE  TRUE FALSE FALSE  TRUE
```

```
train <- subset(iris, split = "TRUE")
test <- subset(iris, split = "FALSE")
train
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
## 1            5.1         3.5          1.4         0.2     setosa
## 2            4.9         3.0          1.4         0.2     setosa
## 3            4.7         3.2          1.3         0.2     setosa
## 4            4.6         3.1          1.5         0.2     setosa
## 5            5.0         3.6          1.4         0.2     setosa
## 6            5.4         3.9          1.7         0.4     setosa
## 7            4.6         3.4          1.4         0.3     setosa
## 8            5.0         3.4          1.5         0.2     setosa
## 9            4.4         2.9          1.4         0.2     setosa
## 10           4.9         3.1          1.5         0.1     setosa
## 11           5.4         3.7          1.5         0.2     setosa
## 12           4.8         3.4          1.6         0.2     setosa
## 13           4.8         3.0          1.4         0.1     setosa
## 14           4.3         3.0          1.1         0.1     setosa
## 15           5.8         4.0          1.2         0.2     setosa
## 16           5.7         4.4          1.5         0.4     setosa
## 17           5.4         3.9          1.3         0.4     setosa
## 18           5.1         3.5          1.4         0.3     setosa
```

```
## 19          5.7         3.8          1.7         0.3     setosa
## 20          5.1         3.8          1.5         0.3     setosa
## 21          5.4         3.4          1.7         0.2     setosa
## 22          5.1         3.7          1.5         0.4     setosa
## 23          4.6         3.6          1.0         0.2     setosa
## 24          5.1         3.3          1.7         0.5     setosa
## 25          4.8         3.4          1.9         0.2     setosa
## 26          5.0         3.0          1.6         0.2     setosa
## 27          5.0         3.4          1.6         0.4     setosa
## 28          5.2         3.5          1.5         0.2     setosa
## 29          5.2         3.4          1.4         0.2     setosa
## 30          4.7         3.2          1.6         0.2     setosa
## 31          4.8         3.1          1.6         0.2     setosa
## 32          5.4         3.4          1.5         0.4     setosa
## 33          5.2         4.1          1.5         0.1     setosa
## 34          5.5         4.2          1.4         0.2     setosa
## 35          4.9         3.1          1.5         0.2     setosa
## 36          5.0         3.2          1.2         0.2     setosa
## 37          5.5         3.5          1.3         0.2     setosa
## 38          4.9         3.6          1.4         0.1     setosa
## 39          4.4         3.0          1.3         0.2     setosa
## 40          5.1         3.4          1.5         0.2     setosa
## 41          5.0         3.5          1.3         0.3     setosa
## 42          4.5         2.3          1.3         0.3     setosa
## 43          4.4         3.2          1.3         0.2     setosa
## 44          5.0         3.5          1.6         0.6     setosa
## 45          5.1         3.8          1.9         0.4     setosa
## 46          4.8         3.0          1.4         0.3     setosa
## 47          5.1         3.8          1.6         0.2     setosa
## 48          4.6         3.2          1.4         0.2     setosa
## 49          5.3         3.7          1.5         0.2     setosa
## 50          5.0         3.3          1.4         0.2     setosa
## 51          7.0         3.2          4.7         1.4 versicolor
## 52          6.4         3.2          4.5         1.5 versicolor
## 53          6.9         3.1          4.9         1.5 versicolor
## 54          5.5         2.3          4.0         1.3 versicolor
## 55          6.5         2.8          4.6         1.5 versicolor
## 56          5.7         2.8          4.5         1.3 versicolor
## 57          6.3         3.3          4.7         1.6 versicolor
## 58          4.9         2.4          3.3         1.0 versicolor
## 59          6.6         2.9          4.6         1.3 versicolor
## 60          5.2         2.7          3.9         1.4 versicolor
## 61          5.0         2.0          3.5         1.0 versicolor
## 62          5.9         3.0          4.2         1.5 versicolor
## 63          6.0         2.2          4.0         1.0 versicolor
## 64          6.1         2.9          4.7         1.4 versicolor
## 65          5.6         2.9          3.6         1.3 versicolor
## 66          6.7         3.1          4.4         1.4 versicolor
## 67          5.6         3.0          4.5         1.5 versicolor
## 68          5.8         2.7          4.1         1.0 versicolor
## 69          6.2         2.2          4.5         1.5 versicolor
## 70          5.6         2.5          3.9         1.1 versicolor
## 71          5.9         3.2          4.8         1.8 versicolor
## 72          6.1         2.8          4.0         1.3 versicolor
```

```
## 73          6.3         2.5          4.9         1.5 versicolor
## 74          6.1         2.8          4.7         1.2 versicolor
## 75          6.4         2.9          4.3         1.3 versicolor
## 76          6.6         3.0          4.4         1.4 versicolor
## 77          6.8         2.8          4.8         1.4 versicolor
## 78          6.7         3.0          5.0         1.7 versicolor
## 79          6.0         2.9          4.5         1.5 versicolor
## 80          5.7         2.6          3.5         1.0 versicolor
## 81          5.5         2.4          3.8         1.1 versicolor
## 82          5.5         2.4          3.7         1.0 versicolor
## 83          5.8         2.7          3.9         1.2 versicolor
## 84          6.0         2.7          5.1         1.6 versicolor
## 85          5.4         3.0          4.5         1.5 versicolor
## 86          6.0         3.4          4.5         1.6 versicolor
## 87          6.7         3.1          4.7         1.5 versicolor
## 88          6.3         2.3          4.4         1.3 versicolor
## 89          5.6         3.0          4.1         1.3 versicolor
## 90          5.5         2.5          4.0         1.3 versicolor
## 91          5.5         2.6          4.4         1.2 versicolor
## 92          6.1         3.0          4.6         1.4 versicolor
## 93          5.8         2.6          4.0         1.2 versicolor
## 94          5.0         2.3          3.3         1.0 versicolor
## 95          5.6         2.7          4.2         1.3 versicolor
## 96          5.7         3.0          4.2         1.2 versicolor
## 97          5.7         2.9          4.2         1.3 versicolor
## 98          6.2         2.9          4.3         1.3 versicolor
## 99          5.1         2.5          3.0         1.1 versicolor
## 100         5.7         2.8          4.1         1.3 versicolor
## 101         6.3         3.3          6.0         2.5  virginica
## 102         5.8         2.7          5.1         1.9  virginica
## 103         7.1         3.0          5.9         2.1  virginica
## 104         6.3         2.9          5.6         1.8  virginica
## 105         6.5         3.0          5.8         2.2  virginica
## 106         7.6         3.0          6.6         2.1  virginica
## 107         4.9         2.5          4.5         1.7  virginica
## 108         7.3         2.9          6.3         1.8  virginica
## 109         6.7         2.5          5.8         1.8  virginica
## 110         7.2         3.6          6.1         2.5  virginica
## 111         6.5         3.2          5.1         2.0  virginica
## 112         6.4         2.7          5.3         1.9  virginica
## 113         6.8         3.0          5.5         2.1  virginica
## 114         5.7         2.5          5.0         2.0  virginica
## 115         5.8         2.8          5.1         2.4  virginica
## 116         6.4         3.2          5.3         2.3  virginica
## 117         6.5         3.0          5.5         1.8  virginica
## 118         7.7         3.8          6.7         2.2  virginica
## 119         7.7         2.6          6.9         2.3  virginica
## 120         6.0         2.2          5.0         1.5  virginica
## 121         6.9         3.2          5.7         2.3  virginica
## 122         5.6         2.8          4.9         2.0  virginica
## 123         7.7         2.8          6.7         2.0  virginica
## 124         6.3         2.7          4.9         1.8  virginica
## 125         6.7         3.3          5.7         2.1  virginica
## 126         7.2         3.2          6.0         1.8  virginica
```

```
## 127          6.2         2.8          4.8         1.8  virginica
## 128          6.1         3.0          4.9         1.8  virginica
## 129          6.4         2.8          5.6         2.1  virginica
## 130          7.2         3.0          5.8         1.6  virginica
## 131          7.4         2.8          6.1         1.9  virginica
## 132          7.9         3.8          6.4         2.0  virginica
## 133          6.4         2.8          5.6         2.2  virginica
## 134          6.3         2.8          5.1         1.5  virginica
## 135          6.1         2.6          5.6         1.4  virginica
## 136          7.7         3.0          6.1         2.3  virginica
## 137          6.3         3.4          5.6         2.4  virginica
## 138          6.4         3.1          5.5         1.8  virginica
## 139          6.0         3.0          4.8         1.8  virginica
## 140          6.9         3.1          5.4         2.1  virginica
## 141          6.7         3.1          5.6         2.4  virginica
## 142          6.9         3.1          5.1         2.3  virginica
## 143          5.8         2.7          5.1         1.9  virginica
## 144          6.8         3.2          5.9         2.3  virginica
## 145          6.7         3.3          5.7         2.5  virginica
## 146          6.7         3.0          5.2         2.3  virginica
## 147          6.3         2.5          5.0         1.9  virginica
## 148          6.5         3.0          5.2         2.0  virginica
## 149          6.2         3.4          5.4         2.3  virginica
## 150          5.9         3.0          5.1         1.8  virginica
```

```
test
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
## 1            5.1         3.5          1.4         0.2     setosa
## 2            4.9         3.0          1.4         0.2     setosa
## 3            4.7         3.2          1.3         0.2     setosa
## 4            4.6         3.1          1.5         0.2     setosa
## 5            5.0         3.6          1.4         0.2     setosa
## 6            5.4         3.9          1.7         0.4     setosa
## 7            4.6         3.4          1.4         0.3     setosa
## 8            5.0         3.4          1.5         0.2     setosa
## 9            4.4         2.9          1.4         0.2     setosa
## 10           4.9         3.1          1.5         0.1     setosa
## 11           5.4         3.7          1.5         0.2     setosa
## 12           4.8         3.4          1.6         0.2     setosa
## 13           4.8         3.0          1.4         0.1     setosa
## 14           4.3         3.0          1.1         0.1     setosa
## 15           5.8         4.0          1.2         0.2     setosa
## 16           5.7         4.4          1.5         0.4     setosa
## 17           5.4         3.9          1.3         0.4     setosa
## 18           5.1         3.5          1.4         0.3     setosa
## 19           5.7         3.8          1.7         0.3     setosa
## 20           5.1         3.8          1.5         0.3     setosa
## 21           5.4         3.4          1.7         0.2     setosa
## 22           5.1         3.7          1.5         0.4     setosa
## 23           4.6         3.6          1.0         0.2     setosa
## 24           5.1         3.3          1.7         0.5     setosa
## 25           4.8         3.4          1.9         0.2     setosa
## 26           5.0         3.0          1.6         0.2     setosa
```

```
## 27          5.0         3.4          1.6         0.4     setosa
## 28          5.2         3.5          1.5         0.2     setosa
## 29          5.2         3.4          1.4         0.2     setosa
## 30          4.7         3.2          1.6         0.2     setosa
## 31          4.8         3.1          1.6         0.2     setosa
## 32          5.4         3.4          1.5         0.4     setosa
## 33          5.2         4.1          1.5         0.1     setosa
## 34          5.5         4.2          1.4         0.2     setosa
## 35          4.9         3.1          1.5         0.2     setosa
## 36          5.0         3.2          1.2         0.2     setosa
## 37          5.5         3.5          1.3         0.2     setosa
## 38          4.9         3.6          1.4         0.1     setosa
## 39          4.4         3.0          1.3         0.2     setosa
## 40          5.1         3.4          1.5         0.2     setosa
## 41          5.0         3.5          1.3         0.3     setosa
## 42          4.5         2.3          1.3         0.3     setosa
## 43          4.4         3.2          1.3         0.2     setosa
## 44          5.0         3.5          1.6         0.6     setosa
## 45          5.1         3.8          1.9         0.4     setosa
## 46          4.8         3.0          1.4         0.3     setosa
## 47          5.1         3.8          1.6         0.2     setosa
## 48          4.6         3.2          1.4         0.2     setosa
## 49          5.3         3.7          1.5         0.2     setosa
## 50          5.0         3.3          1.4         0.2     setosa
## 51          7.0         3.2          4.7         1.4 versicolor
## 52          6.4         3.2          4.5         1.5 versicolor
## 53          6.9         3.1          4.9         1.5 versicolor
## 54          5.5         2.3          4.0         1.3 versicolor
## 55          6.5         2.8          4.6         1.5 versicolor
## 56          5.7         2.8          4.5         1.3 versicolor
## 57          6.3         3.3          4.7         1.6 versicolor
## 58          4.9         2.4          3.3         1.0 versicolor
## 59          6.6         2.9          4.6         1.3 versicolor
## 60          5.2         2.7          3.9         1.4 versicolor
## 61          5.0         2.0          3.5         1.0 versicolor
## 62          5.9         3.0          4.2         1.5 versicolor
## 63          6.0         2.2          4.0         1.0 versicolor
## 64          6.1         2.9          4.7         1.4 versicolor
## 65          5.6         2.9          3.6         1.3 versicolor
## 66          6.7         3.1          4.4         1.4 versicolor
## 67          5.6         3.0          4.5         1.5 versicolor
## 68          5.8         2.7          4.1         1.0 versicolor
## 69          6.2         2.2          4.5         1.5 versicolor
## 70          5.6         2.5          3.9         1.1 versicolor
## 71          5.9         3.2          4.8         1.8 versicolor
## 72          6.1         2.8          4.0         1.3 versicolor
## 73          6.3         2.5          4.9         1.5 versicolor
## 74          6.1         2.8          4.7         1.2 versicolor
## 75          6.4         2.9          4.3         1.3 versicolor
## 76          6.6         3.0          4.4         1.4 versicolor
## 77          6.8         2.8          4.8         1.4 versicolor
## 78          6.7         3.0          5.0         1.7 versicolor
## 79          6.0         2.9          4.5         1.5 versicolor
## 80          5.7         2.6          3.5         1.0 versicolor
```

```
## 81          5.5         2.4          3.8         1.1 versicolor
## 82          5.5         2.4          3.7         1.0 versicolor
## 83          5.8         2.7          3.9         1.2 versicolor
## 84          6.0         2.7          5.1         1.6 versicolor
## 85          5.4         3.0          4.5         1.5 versicolor
## 86          6.0         3.4          4.5         1.6 versicolor
## 87          6.7         3.1          4.7         1.5 versicolor
## 88          6.3         2.3          4.4         1.3 versicolor
## 89          5.6         3.0          4.1         1.3 versicolor
## 90          5.5         2.5          4.0         1.3 versicolor
## 91          5.5         2.6          4.4         1.2 versicolor
## 92          6.1         3.0          4.6         1.4 versicolor
## 93          5.8         2.6          4.0         1.2 versicolor
## 94          5.0         2.3          3.3         1.0 versicolor
## 95          5.6         2.7          4.2         1.3 versicolor
## 96          5.7         3.0          4.2         1.2 versicolor
## 97          5.7         2.9          4.2         1.3 versicolor
## 98          6.2         2.9          4.3         1.3 versicolor
## 99          5.1         2.5          3.0         1.1 versicolor
## 100         5.7         2.8          4.1         1.3 versicolor
## 101         6.3         3.3          6.0         2.5  virginica
## 102         5.8         2.7          5.1         1.9  virginica
## 103         7.1         3.0          5.9         2.1  virginica
## 104         6.3         2.9          5.6         1.8  virginica
## 105         6.5         3.0          5.8         2.2  virginica
## 106         7.6         3.0          6.6         2.1  virginica
## 107         4.9         2.5          4.5         1.7  virginica
## 108         7.3         2.9          6.3         1.8  virginica
## 109         6.7         2.5          5.8         1.8  virginica
## 110         7.2         3.6          6.1         2.5  virginica
## 111         6.5         3.2          5.1         2.0  virginica
## 112         6.4         2.7          5.3         1.9  virginica
## 113         6.8         3.0          5.5         2.1  virginica
## 114         5.7         2.5          5.0         2.0  virginica
## 115         5.8         2.8          5.1         2.4  virginica
## 116         6.4         3.2          5.3         2.3  virginica
## 117         6.5         3.0          5.5         1.8  virginica
## 118         7.7         3.8          6.7         2.2  virginica
## 119         7.7         2.6          6.9         2.3  virginica
## 120         6.0         2.2          5.0         1.5  virginica
## 121         6.9         3.2          5.7         2.3  virginica
## 122         5.6         2.8          4.9         2.0  virginica
## 123         7.7         2.8          6.7         2.0  virginica
## 124         6.3         2.7          4.9         1.8  virginica
## 125         6.7         3.3          5.7         2.1  virginica
## 126         7.2         3.2          6.0         1.8  virginica
## 127         6.2         2.8          4.8         1.8  virginica
## 128         6.1         3.0          4.9         1.8  virginica
## 129         6.4         2.8          5.6         2.1  virginica
## 130         7.2         3.0          5.8         1.6  virginica
## 131         7.4         2.8          6.1         1.9  virginica
## 132         7.9         3.8          6.4         2.0  virginica
## 133         6.4         2.8          5.6         2.2  virginica
## 134         6.3         2.8          5.1         1.5  virginica
```

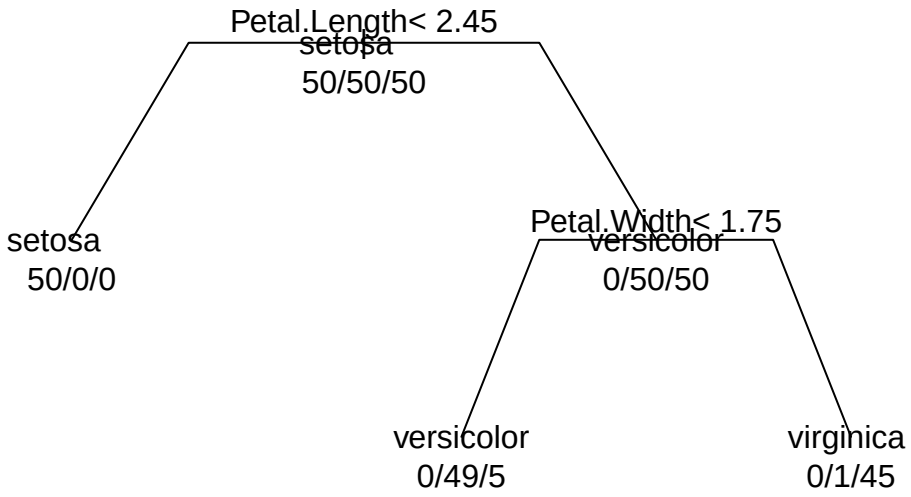
```
## 135          6.1         2.6          5.6         1.4  virginica
## 136          7.7         3.0          6.1         2.3  virginica
## 137          6.3         3.4          5.6         2.4  virginica
## 138          6.4         3.1          5.5         1.8  virginica
## 139          6.0         3.0          4.8         1.8  virginica
## 140          6.9         3.1          5.4         2.1  virginica
## 141          6.7         3.1          5.6         2.4  virginica
## 142          6.9         3.1          5.1         2.3  virginica
## 143          5.8         2.7          5.1         1.9  virginica
## 144          6.8         3.2          5.9         2.3  virginica
## 145          6.7         3.3          5.7         2.5  virginica
## 146          6.7         3.0          5.2         2.3  virginica
## 147          6.3         2.5          5.0         1.9  virginica
## 148          6.5         3.0          5.2         2.0  virginica
## 149          6.2         3.4          5.4         2.3  virginica
## 150          5.9         3.0          5.1         1.8  virginica
```

```
decision_tree_model <- rpart(Species ~., data = train, method = "class")
summary(decision_tree_model)
```

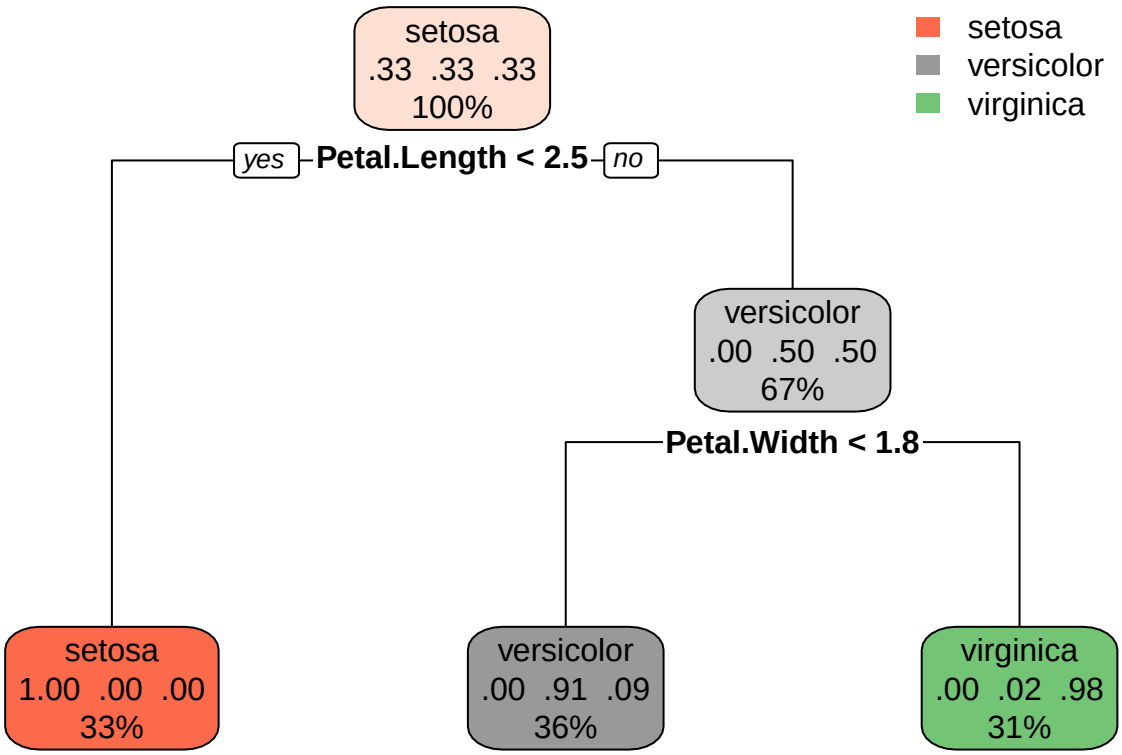
```
## Call:
## rpart(formula = Species ~ ., data = train, method = "class")
##   n= 150
##
##     CP nsplit rel error xerror       xstd
## 1 0.50      0      1.00   1.14 0.05230679
## 2 0.44      1      0.50   0.60 0.06000000
## 3 0.01      2      0.06   0.09 0.02908608
##
## Variable importance
##  Petal.Width Petal.Length Sepal.Length  Sepal.Width
##           34           31           21           14
##
## Node number 1: 150 observations,    complexity param=0.5
##   predicted class=setosa      expected loss=0.6666667  P(node) =1
##     class counts:    50    50    50
##    probabilities: 0.333 0.333 0.333
##   left son=2 (50 obs) right son=3 (100 obs)
##   Primary splits:
##       Petal.Length < 2.45 to the left,  improve=50.00000, (0 missing)
##       Petal.Width  < 0.8  to the left,  improve=50.00000, (0 missing)
##       Sepal.Length < 5.45 to the left,  improve=34.16405, (0 missing)
##       Sepal.Width  < 3.35 to the right, improve=19.03851, (0 missing)
##   Surrogate splits:
##       Petal.Width  < 0.8  to the left,  agree=1.000, adj=1.00, (0 split)
##       Sepal.Length < 5.45 to the left,  agree=0.920, adj=0.76, (0 split)
##       Sepal.Width  < 3.35 to the right, agree=0.833, adj=0.50, (0 split)
##
## Node number 2: 50 observations
##   predicted class=setosa      expected loss=0  P(node) =0.3333333
##     class counts:    50     0     0
##    probabilities: 1.000 0.000 0.000
##
## Node number 3: 100 observations,    complexity param=0.44
```

```
##   predicted class=versicolor  expected loss=0.5  P(node) =0.6666667
##     class counts:     0    50    50
##    probabilities: 0.000 0.500 0.500
##   left son=6 (54 obs) right son=7 (46 obs)
##   Primary splits:
##       Petal.Width  < 1.75 to the left,  improve=38.969400, (0 missing)
##       Petal.Length < 4.75 to the left,  improve=37.353540, (0 missing)
##       Sepal.Length < 6.15 to the left,  improve=10.686870, (0 missing)
##       Sepal.Width  < 2.45 to the left,  improve= 3.555556, (0 missing)
##   Surrogate splits:
##       Petal.Length < 4.75 to the left,  agree=0.91, adj=0.804, (0 split)
##       Sepal.Length < 6.15 to the left,  agree=0.73, adj=0.413, (0 split)
##       Sepal.Width  < 2.95 to the left,  agree=0.67, adj=0.283, (0 split)
##
## Node number 6: 54 observations
##   predicted class=versicolor  expected loss=0.09259259  P(node) =0.36
##     class counts:     0    49     5
##    probabilities: 0.000 0.907 0.093
##
## Node number 7: 46 observations
##   predicted class=virginica   expected loss=0.02173913  P(node) =0.3066667
##     class counts:     0     1    45
##    probabilities: 0.000 0.022 0.978
```

```
plot(decision_tree_model,uniform = TRUE , branch = 0.6, margin = 0.1)
text(decision_tree_model, all = TRUE, use.n=TRUE)
```



```
library(rpart.plot)
rpart.plot(decision_tree_model)
```




```
#predict
test$Species_predicted<-predict(decision_tree_model,newdata=test,type="class")
table(test$Species, test$Species_predicted)
```

```
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
```

```
library(caret)
```

```
## Loading required package: lattice
```

```
## Loading required package: ggplot2
```

```
confusionMatrix(table(test$Species, test$Species_predicted))
```

```
## Confusion Matrix and Statistics
```

```
##
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
##
## Overall Statistics
##
##                Accuracy : 0.96
##                  95% CI : (0.915, 0.9852)
##     No Information Rate : 0.36
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.94
##
##  Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                      Class: setosa Class: versicolor Class: virginica
## Sensitivity                 1.0000            0.9074           0.9783
## Specificity                 1.0000            0.9896           0.9519
## Pos Pred Value              1.0000            0.9800           0.9000
## Neg Pred Value              1.0000            0.9500           0.9900
## Prevalence                  0.3333            0.3600           0.3067
## Detection Rate              0.3333            0.3267           0.3000
## Detection Prevalence        0.3333            0.3333           0.3333
## Balanced Accuracy           1.0000            0.9485           0.9651
```

Pruning

```
?printcp
```

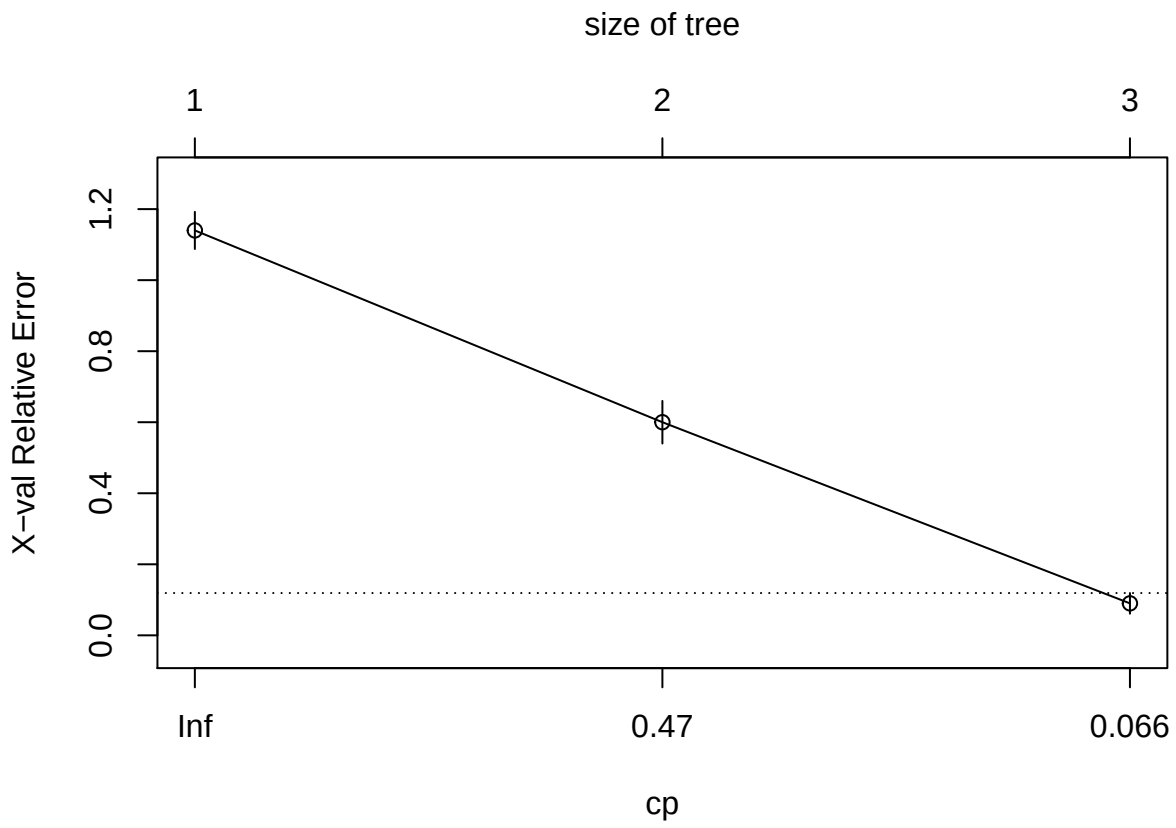
```
## starting httpd help server ... done
```

```
printcp(decision_tree_model)
```

```
##
## Classification tree:
## rpart(formula = Species ~ ., data = train, method = "class")
##
## Variables actually used in tree construction:
## [1] Petal.Length Petal.Width
##
## Root node error: 100/150 = 0.66667
##
## n= 150
##
##     CP nsplit rel error xerror     xstd
```

```
## 1 0.50      0      1.00   1.14 0.052307
## 2 0.44      1      0.50   0.60 0.060000
## 3 0.01      2      0.06   0.09 0.029086
```

```
plotcp(decision_tree_model)
```



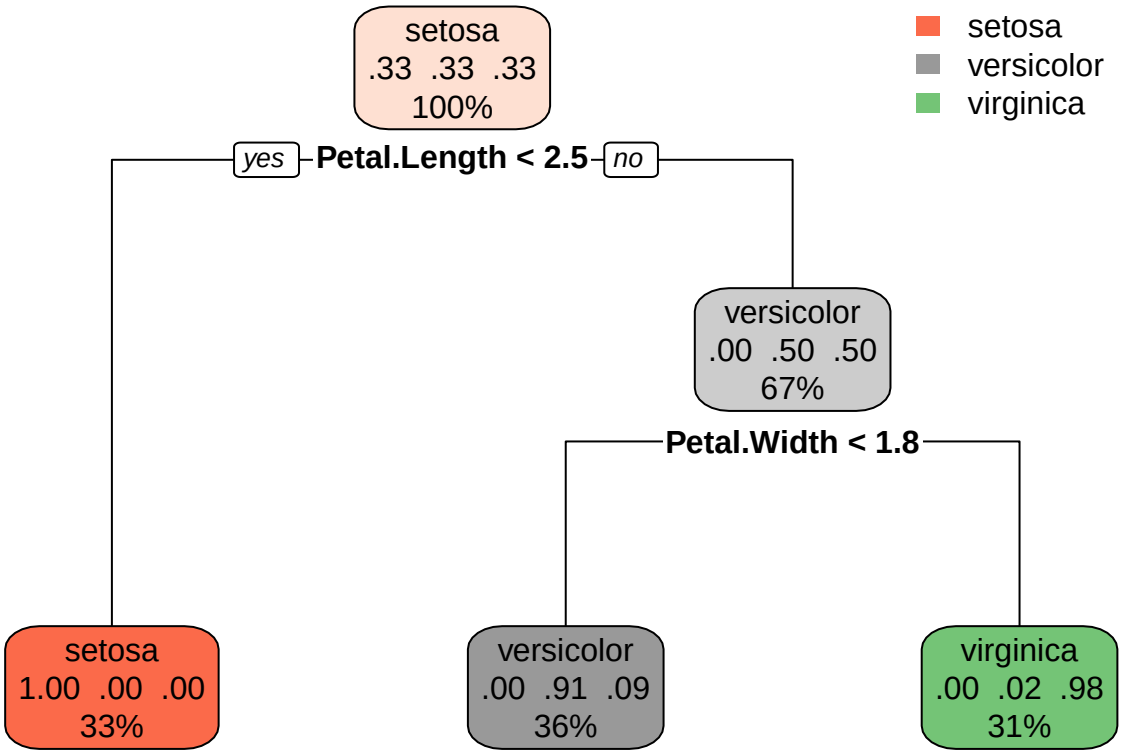

```
min(decision_tree_model$cptable[,"xerror"])
```

```
## [1] 0.09
```

```
which.min(decision_tree_model$cptable[,"xerror"])
```

```
## 3
## 3
```

```
cpmin <- decision_tree_model$cptable[3,"CP"]
decison_tree_pruned = prune(decision_tree_model, cp = cpmin)
rpart.plot(decison_tree_pruned)
```




```
#predict based on test data
test$Species_predicted<-predict(decison_tree_pruned,newdata=test,type="class")
table(test$Species, test$Species_predicted)
```

```
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
```

```
confusionMatrix(table(test$Species, test$Species_predicted))
```

```
## Confusion Matrix and Statistics
##
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
##
## Overall Statistics
##
##                Accuracy : 0.96
##                  95% CI : (0.915, 0.9852)
##     No Information Rate : 0.36
```

```
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.94
##
##  Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                      Class: setosa Class: versicolor Class: virginica
## Sensitivity                 1.0000            0.9074           0.9783
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## Pos Pred Value              1.0000            0.9800           0.9000
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## Prevalence                  0.3333            0.3600           0.3067
## Detection Rate              0.3333            0.3267           0.3000
## Detection Prevalence        0.3333            0.3333           0.3333
## Balanced Accuracy           1.0000            0.9485           0.9651
```
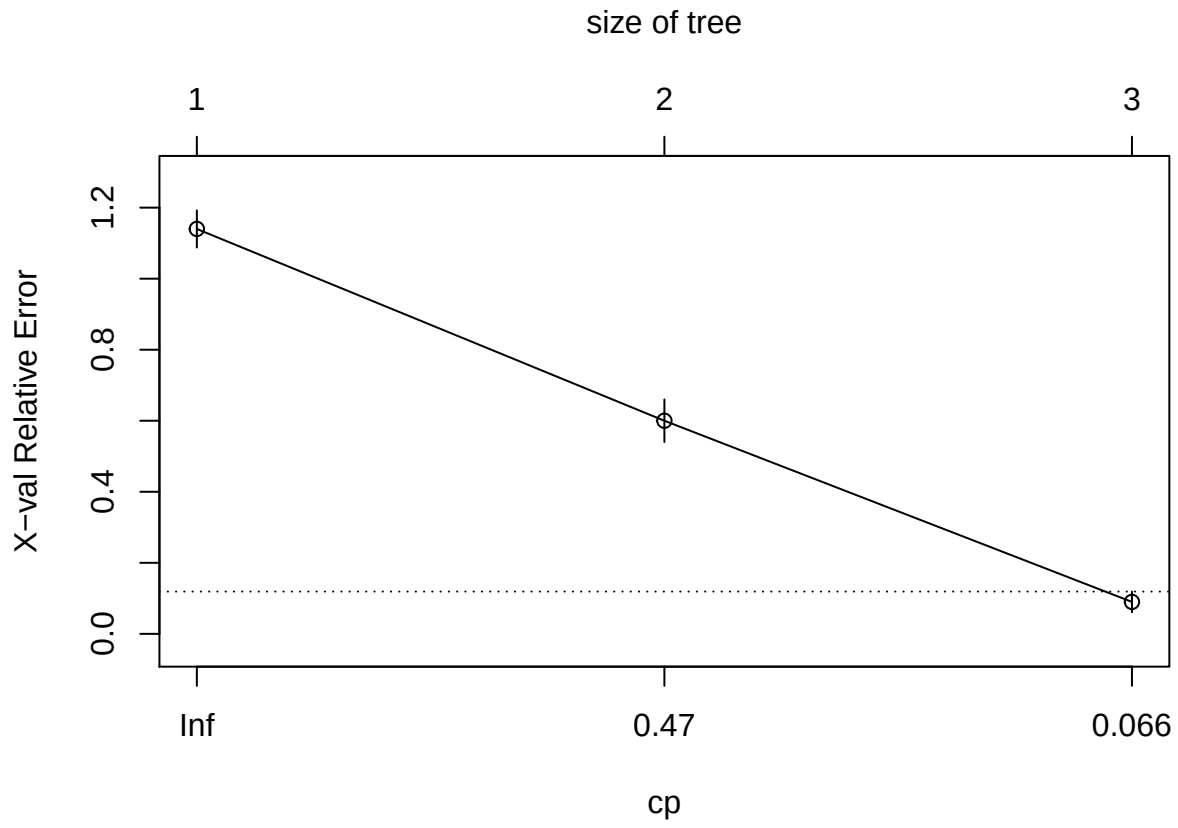

#we see minimum error when N = 3

```
plotcp(decision_tree_model)
```



#find the cp value for which corss validation is minimum

```
min(decision_tree_model$cptable[,"xerror"])
```

```
## [1] 0.09
```

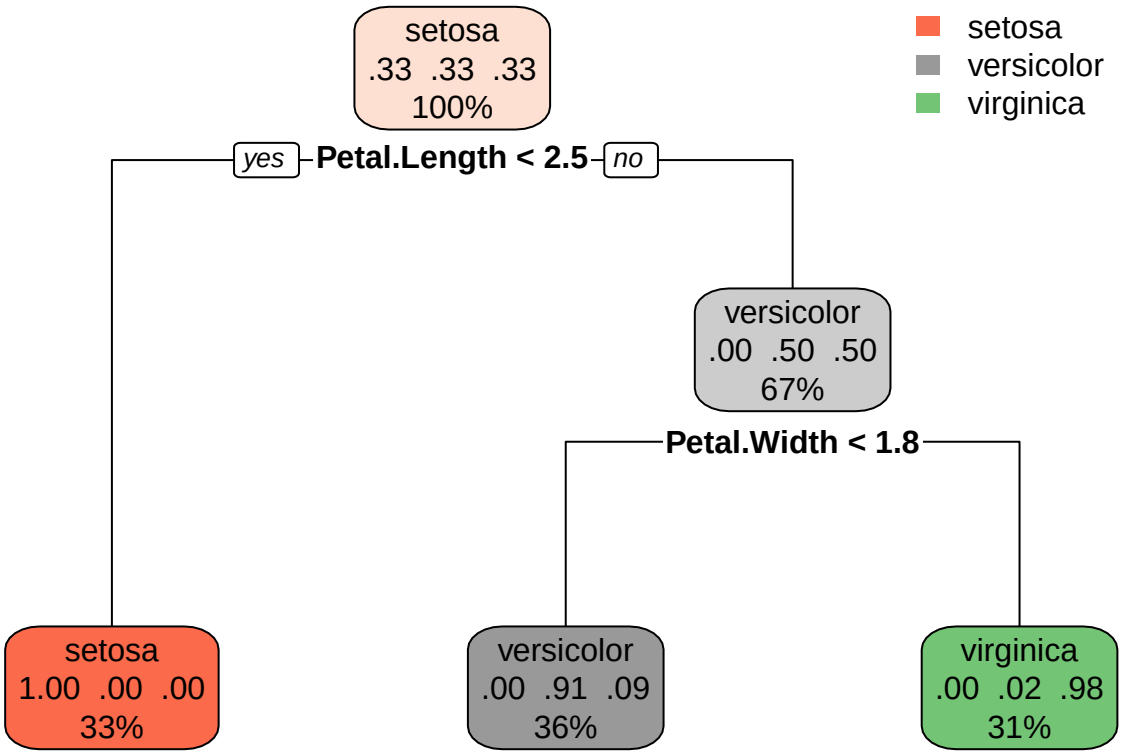
```
which.min(decision_tree_model$cptable[,"xerror"])
```

```
## 3
## 3
```

```
cpmin <- decision_tree_model$cptable[3,"CP"]
```

#prune the tree by setting cp value as Cpmin

```
decison_tree_pruned = prune(decision_tree_model, cp = cpmin)
rpart.plot(decison_tree_pruned)
```




```
#predict based on test data
test$Species_predicted<-predict(decison_tree_pruned,newdata=test,type="class")
table(test$Species, test$Species_predicted)
```

```
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
```

```
confusionMatrix(table(test$Species, test$Species_predicted))
```

```
## Confusion Matrix and Statistics
##
##
##              setosa versicolor virginica
##   setosa         50          0         0
##   versicolor      0         49         1
##   virginica       0          5        45
##
## Overall Statistics
##
##                Accuracy : 0.96
##                  95% CI : (0.915, 0.9852)
##     No Information Rate : 0.36
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                   Kappa : 0.94
##
##  Mcnemar's Test P-Value : NA
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## Statistics by Class:
##
##                      Class: setosa Class: versicolor Class: virginica
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## Pos Pred Value              1.0000            0.9800           0.9000
## Neg Pred Value              1.0000            0.9500           0.9900
## Prevalence                  0.3333            0.3600           0.3067
## Detection Rate              0.3333            0.3267           0.3000
## Detection Prevalence        0.3333            0.3333           0.3333
## Balanced Accuracy           1.0000            0.9485           0.9651
```