Heart Disease

Train classification models on patient data to predict heart disease diagnosis.

Import and Prepare Data

Load the example data and extract numerical predictors.

```
heartData = readtable("heartDiseaseData.csv");
heartData = convertvars(heartData,12:22,"categorical");
heartDataNum = heartData(:,[1:11 22]);
```

Partition into training and test sets.

```
rng(1234)
pt = cvpartition(heartData.HeartDisease,"Holdout",0.2);
hdTrainNum = heartDataNum(training(pt),:);
hdTestNum = heartDataNum(~training(pt),:);
hdTrain = heartData(training(pt),:);
hdTest = heartData(~training(pt),:);
```

kNN Classification

```
mdl = fitcknn(hdTrainNum,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0
```

```
loss(mdl,hdTestNum)
```

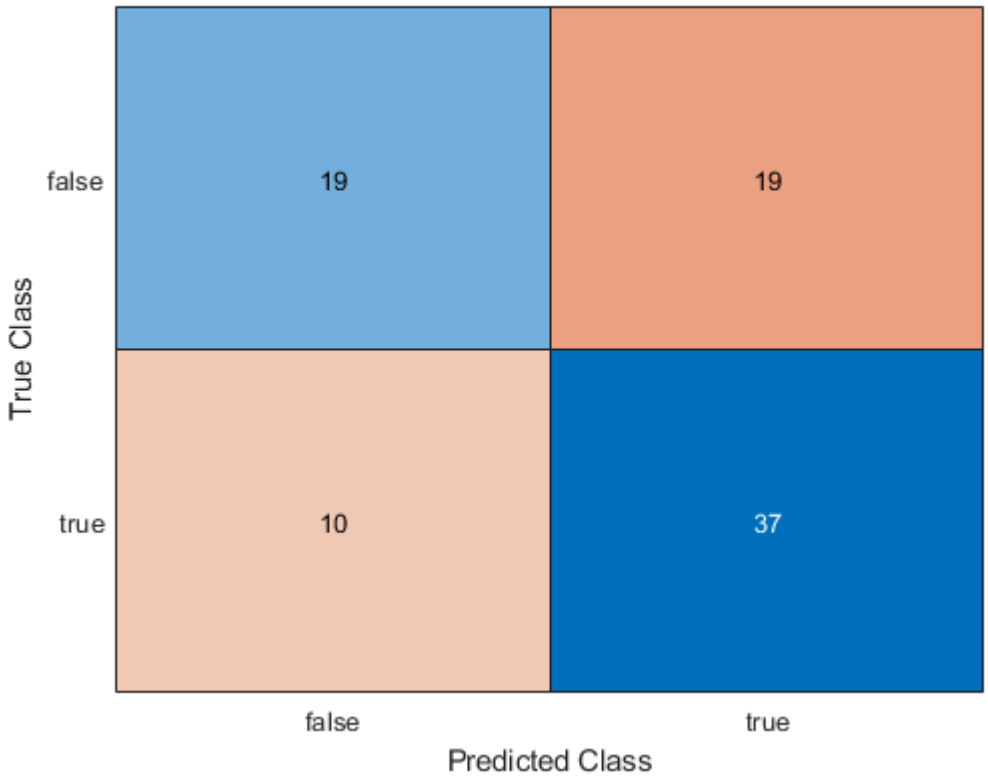
```
ans = 0.3413
```

Visualize prediction accuracy.

```
HDpred = predict(mdl,hdTestNum);
HDtrue = hdTestNum.HeartDisease;
[cm,grp] = confusionmat(HDtrue,HDpred)
```

```
cm = 2×2
    19    19
    10    37
grp = 2×1 categorical
false
true
```

```
confusionchart(HDtrue,HDpred);
```



Increase the number of neighbors.

```
mdl.NumNeighbors = 5;
resubLoss(mdl)
```

```
ans = 0.2222
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.2471
```

Change the distance weighting option.

```
mdl.DistanceWeight = "squaredinverse";
resubLoss(mdl)
```

```
ans = 0
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.2471
```

Decision Trees

Fit and evaluate a decision tree model with default settings.

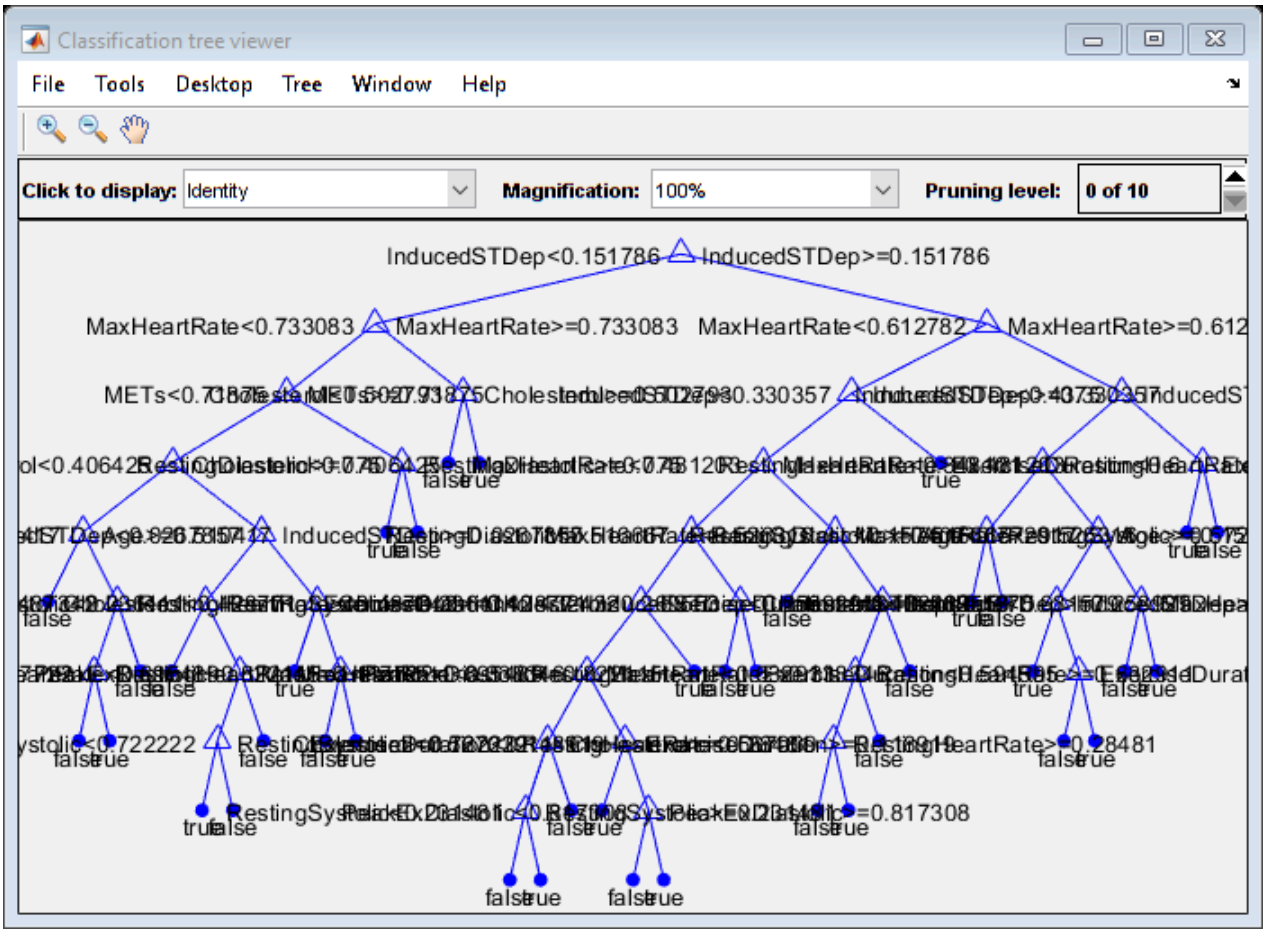
```
mdl = fitctree(hdTrainNum,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.0789
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.2706
```

```
view(mdl,"mode","graph")
```



Prune the tree.

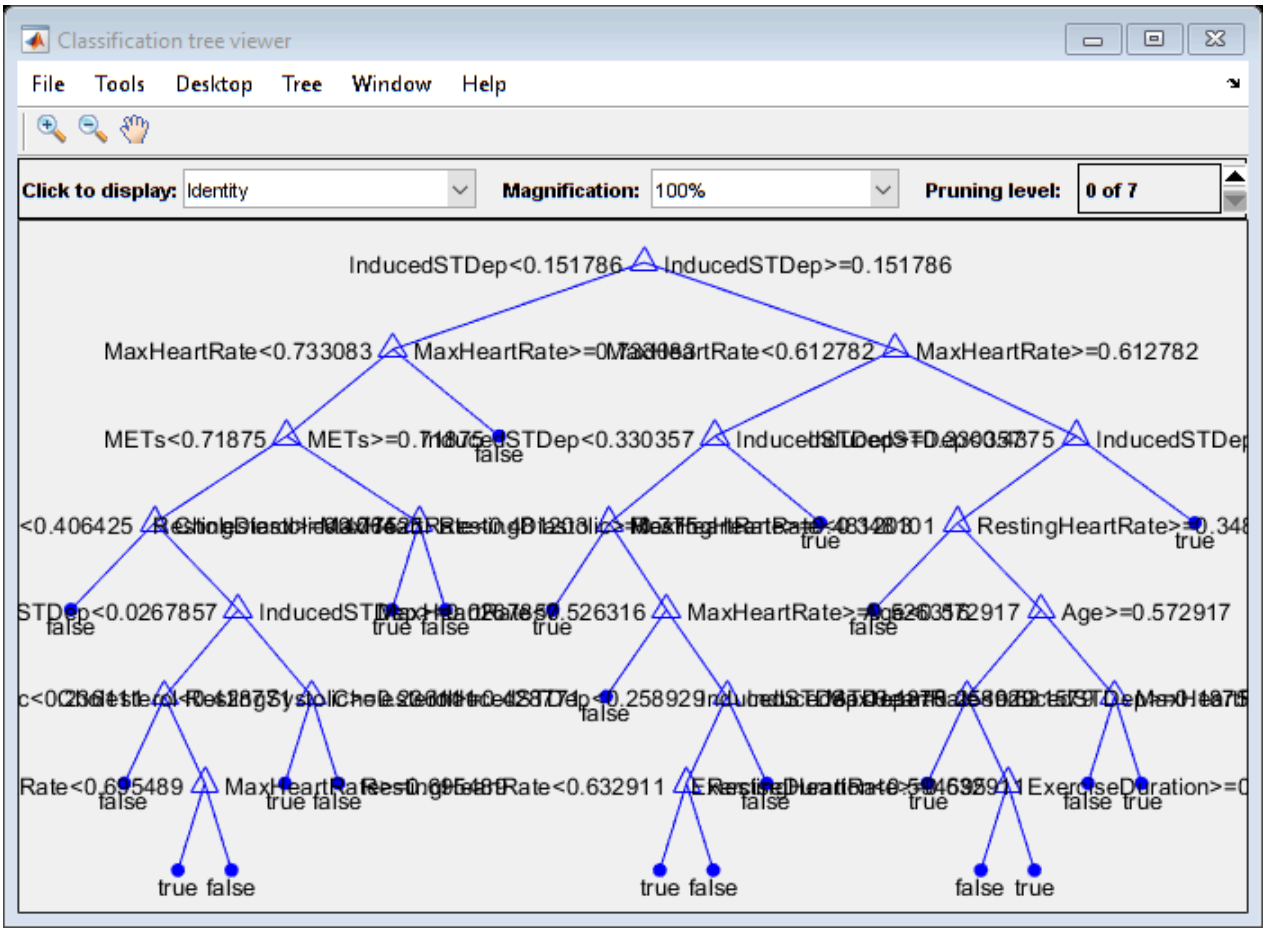
```
mdl = prune(mdl,"Level",3);
resubLoss(mdl)
```

```
ans = 0.1404
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.1883
```

```
view(mdl,"mode","graph")
```



Use a mix of numeric and categorical predictors.

```
mdl = fitctree(hdTrain,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.0526
```

```
loss(mdl,hdTest)
```

```
ans = 0.2471
```

```
mdl = prune(mdl,"Level",3);
resubLoss(mdl)
```

```
ans = 0.0994
```

```
loss(mdl,hdTest)
```

```
ans = 0.2118
```

Naive Bayes

Fit and evaluate a Naive Bayes model with default settings.

```
mdl = fitcnb(hdTrainNum,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.2982
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.2000
```

Use kernel smoothing instead of normal distributions.

```
mdl = fitcnb(hdTrainNum,"HeartDisease","DistributionNames","kernel");
resubLoss(mdl)
```

```
ans = 0.2602
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.1765
```

Use a mix of numeric and categorical predictors.

```
mdl = fitcnb(hdTrain,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.2047
```

```
loss(mdl,hdTest)
```

```
ans = 0.1177
```

Use kernel smoothing instead of normal distributions.

```
dists = [repmat("kernel",1,11) repmat("mvmn",1,10)];
mdl = fitcnb(hdTrain,"HeartDisease","DistributionNames",dists);
resubLoss(mdl)
```

```
ans = 0.1959
```

```
loss(mdl,hdTest)
```

```
ans = 0.1412
```

Discriminant Analysis

Fit and evaluate a linear discriminant model with default settings.

```
mdl = fitcdiscr(hdTrainNum,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.2719
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.1765
```

Use a quadratic boundary.

```
mdl = fitcdiscr(hdTrainNum,"HeartDisease","DiscrimType","quadratic");
```

```
resubLoss(mdl)
```

```
ans = 0.2485
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.2706
```

SVM

Fit and evaluate an SVM with default settings.

```
mdl = fitcsvm(hdTrainNum,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.3012
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.1647
```

Use a nonlinear kernel.

```
mdl = fitcsvm(hdTrainNum,"HeartDisease","KernelFunction","gaussian");
resubLoss(mdl)
```

```
ans = 0.2602
```

```
loss(mdl,hdTestNum)
```

```
ans = 0.1647
```

Use a mix of numeric and categorical predictors.

```
mdl = fitcsvm(hdTrain,"HeartDisease");
resubLoss(mdl)
```

```
ans = 0.1901
```

```
loss(mdl,hdTest)
```

```
ans = 0.1530
```

Use a nonlinear kernel.

```
mdl = fitcsvm(hdTrain,"HeartDisease","KernelFunction","gaussian");
resubLoss(mdl)
```

```
ans = 0.0409
```

```
loss(mdl,hdTest)
```

```
ans = 0.1765
```

Multiclass SVM

Load and partition multiclass heart disease data set.

```
heartDataMulti = readtable("heartDiseaseDataMulticlass.csv");
heartDataMulti = convertvars(heartDataMulti,12:22,"categorical");
hdMTrain = heartDataMulti(training(pt),:);
hdMTest = heartDataMulti(~training(pt),:);
hdMTrainNum = heartDataMulti(training(pt),[1:11 22]);
hdMTestNum = heartDataMulti(~training(pt),[1:11 22]);
```

Linear SVM

```
mdl = fitcecoc(hdMTrainNum,"HeartDisease");
linResubLoss = resubLoss(mdl)
```

```
linResubLoss = 0.5058
```

```
linTestLoss = loss(mdl,hdMTestNum)
```

```
linTestLoss = 0.5002
```

Gaussian SVM

```
template = templateSVM("KernelFunction","gaussian");
mdl = fitcecoc(hdMTrainNum,"HeartDisease","Learners",template);
gaussResubLoss = resubLoss(mdl)
```

```
gaussResubLoss = 0.4591
```

```
gaussTestLoss = loss(mdl,hdMTestNum)
```

```
gaussTestLoss = 0.4893
```

Linear SVM with mixed predictors

```
mdl = fitcecoc(hdMTrain,"HeartDisease");
mixedLinResubLoss = resubLoss(mdl)
```

```
mixedLinResubLoss = 0.4064
```

```
mixedLinTestLoss = loss(mdl,hdMTest)
```

```
mixedLinTestLoss = 0.5442
```

Gaussian SVM with mixed predictors

```
template = templateSVM("KernelFunction","gaussian");
mdl = fitcecoc(hdMTrain,"HeartDisease","Learners",template);
mixedGaussResubLoss = resubLoss(mdl)
```

```
mixedGaussResubLoss = 0.1520
```

```
mixedGaussTestLoss = loss(mdl,hdMTest)
```

```
mixedGaussTestLoss = 0.5064
```