Train Topographic Map Network

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Live script used to train topographic map network

```
tic
path = pwd;
cd ../../eeglab/ % replace with EEGlab path
eeglab
```

```
Some menus items hidden. Use Preference menu to show them all.
eeglab: options file is C:\Users\nonun\eeg_options.m
Retrieving plugin versions from server...
Retrieving download statistics...
EEGLAB: adding "Biosig" to the path; subfolders (if any) might be missing from the path
EEGLAB: adding "ICLabel" v1.3 (see >> help eegplugin_iclabel) - new version 1.4 available
EEGLAB: adding "clean_rawdata" v2.6 (see >> help eegplugin_clean_rawdata) - new version 2.7 available
EEGLAB: adding "dipfit" v4.3 (see >> help eegplugin_dipfit)
EEGLAB: adding "firfilt" v2.4 (see >> help eegplugin_firfilt) - new version 2.6 available
EEGLAB: adding "xdfimport" v1.18 (see >> help eegplugin_xdfimport)
Warning:
A newer revision of EEGLAB (v2022.1) is available HERE.

See Release notes for more information
You may disable this message in the File > Preferences menu.
```

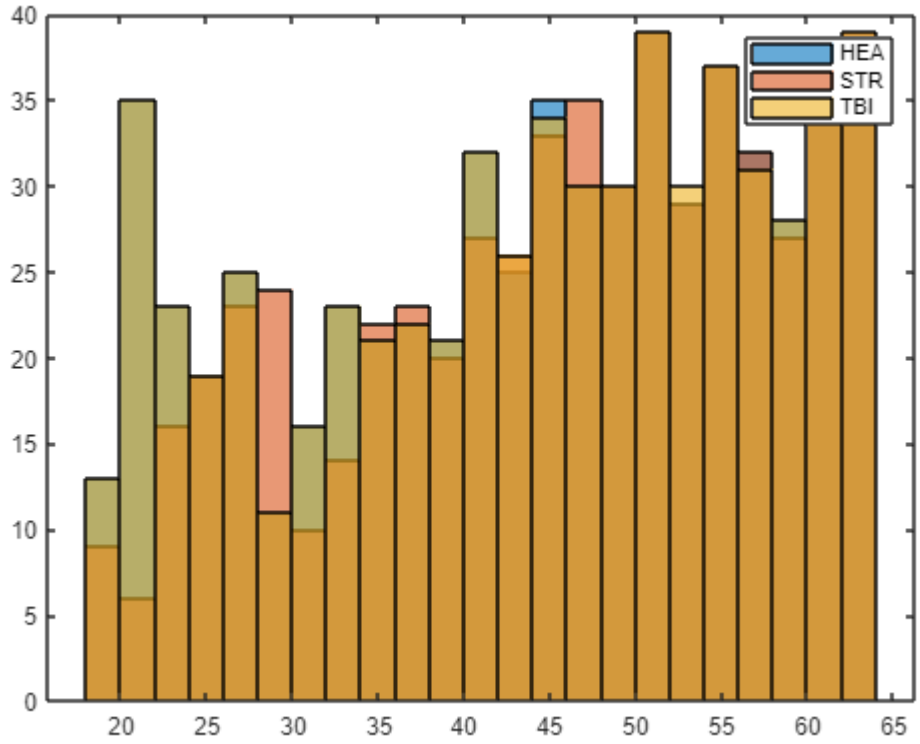
```
close
cd (pwd)
load("chlocs2.mat")
%Make TopoDatastore
fol = "D:\3minSept22";
ds_all = TopoDatastore(fol,[],channel_locations);
toc
```

```
Elapsed time is 256.766027 seconds.
```

Used Matched Age and Gender subjects/sessions of HEA and STR

```
[HEA,STR,TBI] = MatchSubjects();
```

```
# HEA subjects/sessions: 595/629
# STR subjects/sessions: 527/585
# TBI subjects/sessions: 552/629
```




```
s = split(HEA.Location,'\');
s = string(s(:,9));
s = split(s,'.');
HEA = s(:,1);
s = split(STR.Location,'\');
s = string(s(:,9));
s = split(s,'.');
STR = s(:,1);
s = split(TBI.Location,'\');
s = string(s(:,9));
s = split(s,'.');
TBI = s(:,1);
```

Check for overlaps

```
f = string(ds_all.Datastore.Files);
in_HEA = [];
in_STR = [];
in_TBI = [];
for i = 1:length(f)
    for j = 1:length(HEA)
        if contains(f(i),HEA(j))
            in_HEA = [in_HEA i];
            break
        end
    end
```

```
    for j = 1:length(STR)
        if contains(f(i),STR(j))
            in_STR = [in_STR i];
            break
        end
    end
    for j = 1:length(TBI)
        if contains(f(i),TBI(j))
            in_TBI = [in_TBI i];
            break
        end
    end
end
%in_TBI = find(ds_all.Labels == "TBI")';
in = [in_HEA, in_STR, in_TBI];
ds_match = subset(ds_all,in);
%ds_match_test = subset(ds_test,in);
```

Set aside >=50 samples for IV

```
c = string(categories(ds_match.Labels));
numsub = max(50,floor(min(countcats(ds_match.Labels))*.2));
disp("Using " + numsub + " for IV.")
```

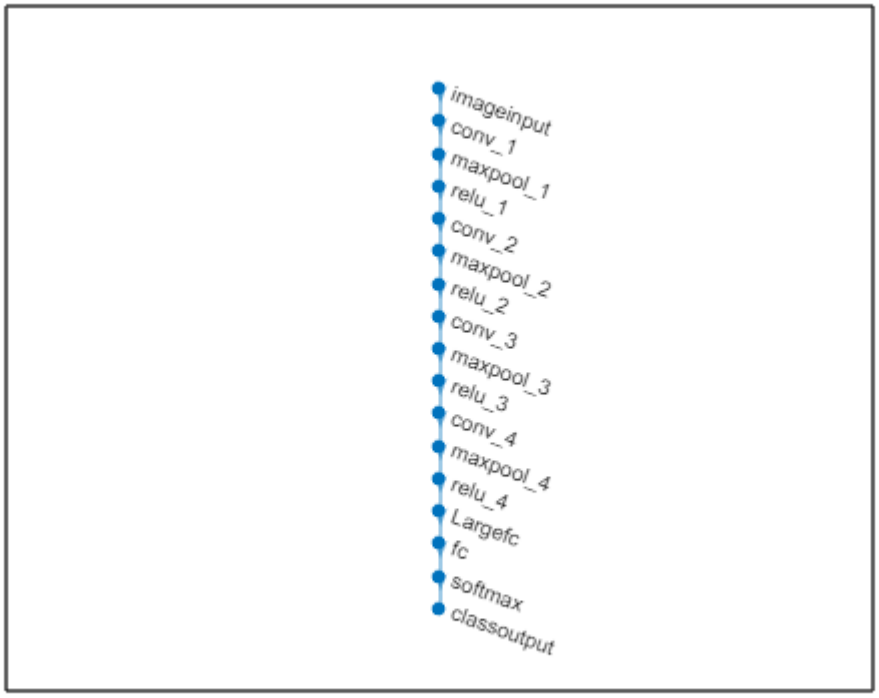
```
Using 569 for IV.
```

```
in_iv = [];
in_cv = [];
for i = 1:length(c)
    in = find(ds_match.Labels == c(i));
    r = randperm(length(in));
    in_iv = [in_iv; in(r(1:numsub))];
    in_cv = [in_cv; in(r(numsub+1:end))];
end
X_Train=subset(ds_match,in_cv);
X_Test=subset(ds_match,in_iv);
```

Layers

```
numclasses = X_Train.NumClasses;
layers = [
    imageInputLayer([134 134 6],"Name","imageinput","Normalization","none")
    convolution2dLayer([3 3],32,"Name","conv_1")
    maxPooling2dLayer([3 3],"Name","maxpool_1","Stride",[1 1])
    reluLayer("Name","relu_1")
    convolution2dLayer([3 3],32,"Name","conv_2")
    maxPooling2dLayer([3 3],"Name","maxpool_2","Stride",[2 2])
    reluLayer("Name","relu_2")
    convolution2dLayer([3 3],64,"Name","conv_3")
    maxPooling2dLayer([3 3],"Name","maxpool_3","Stride",[1 1])
```

```
    reluLayer("Name","relu_3")
    convolution2dLayer([3 3],128,"Name","conv_4")
    maxPooling2dLayer([3 3],"Name","maxpool_4","Stride",[2 2])
    reluLayer("Name","relu_4")
    fullyConnectedLayer(100,"Name","Largefc")
    fullyConnectedLayer(numclasses,"Name","fc")
    softmaxLayer("Name","softmax")
    classificationLayer("Name","classoutput")];
figure;
plot(layerGraph(layers));
```



Generate Local Data

6GB RAM needed. Only need to run one time.

```
% y = zeros(134,134,6,length(X_Train.Labels)); %~6Gb
% X_Train.MiniBatchSize = 1;
% reset(X_Train)
% for i = 1:length(X_Train.Labels)
%     temp = read(X_Train);
%     y(:,:,:,i) = temp.Predictors{1};
% end
```

```
Warning: For increased performance, remaining outputs are not shown. Consider reducing the number of outputs.
```

```
% v = zeros(134,134,6,length(X_Test.Labels)); %~6Gb
% X_Test.MiniBatchSize = 1;
```

```
% reset(X_Test)
% for i = 1:length(X_Test.Labels)
%     temp = read(X_Test);
%     v(:,:,:,i) = temp.Predictors{1};
% end
% save('TopoData.mat',"v","y","X_Train","X_Test",'-v7.3');
```

Due to the large file size, an example file is not included for this dataset. To reproduce use the code above.

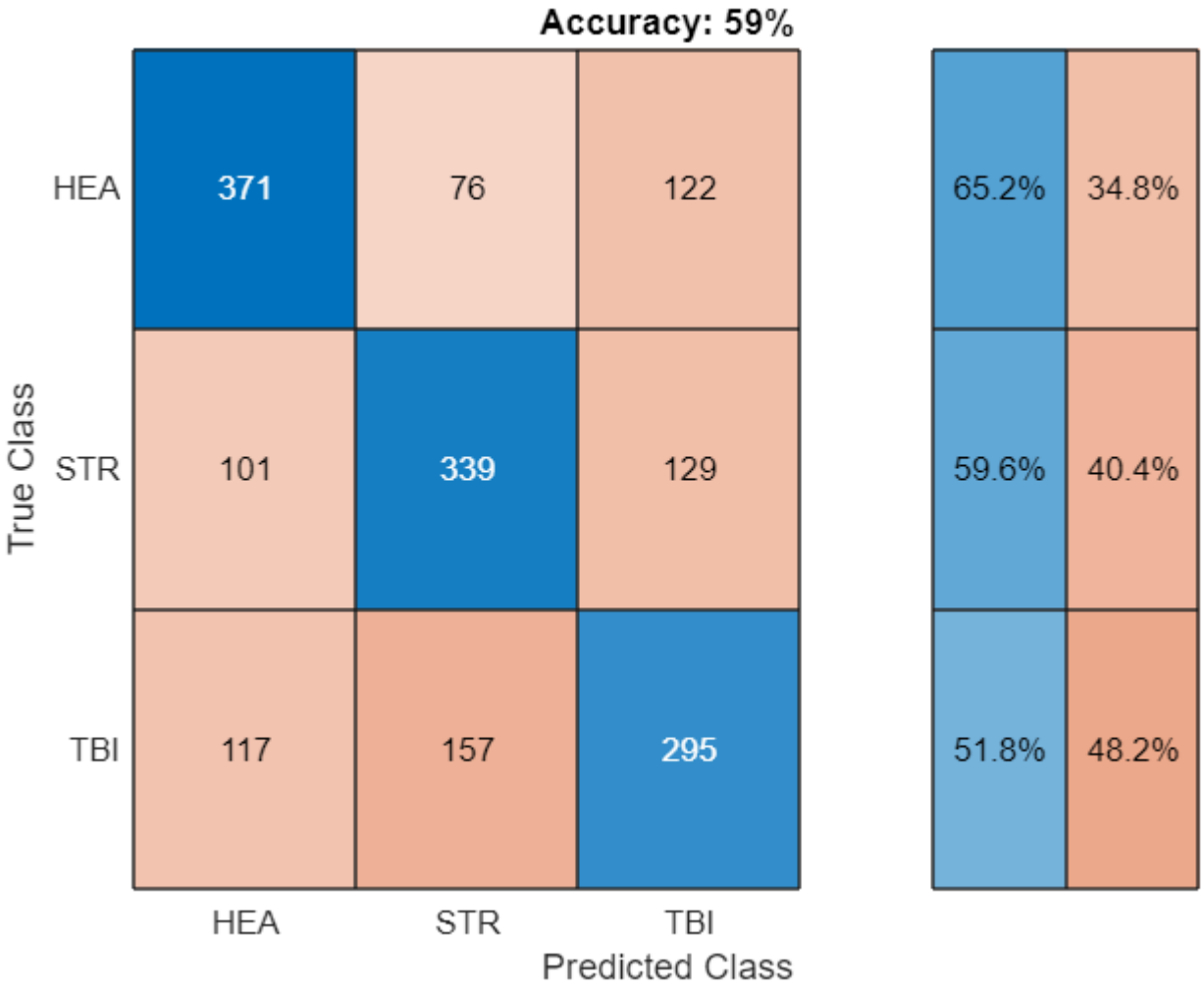
```
load('TopoData.mat');
```

Run Network

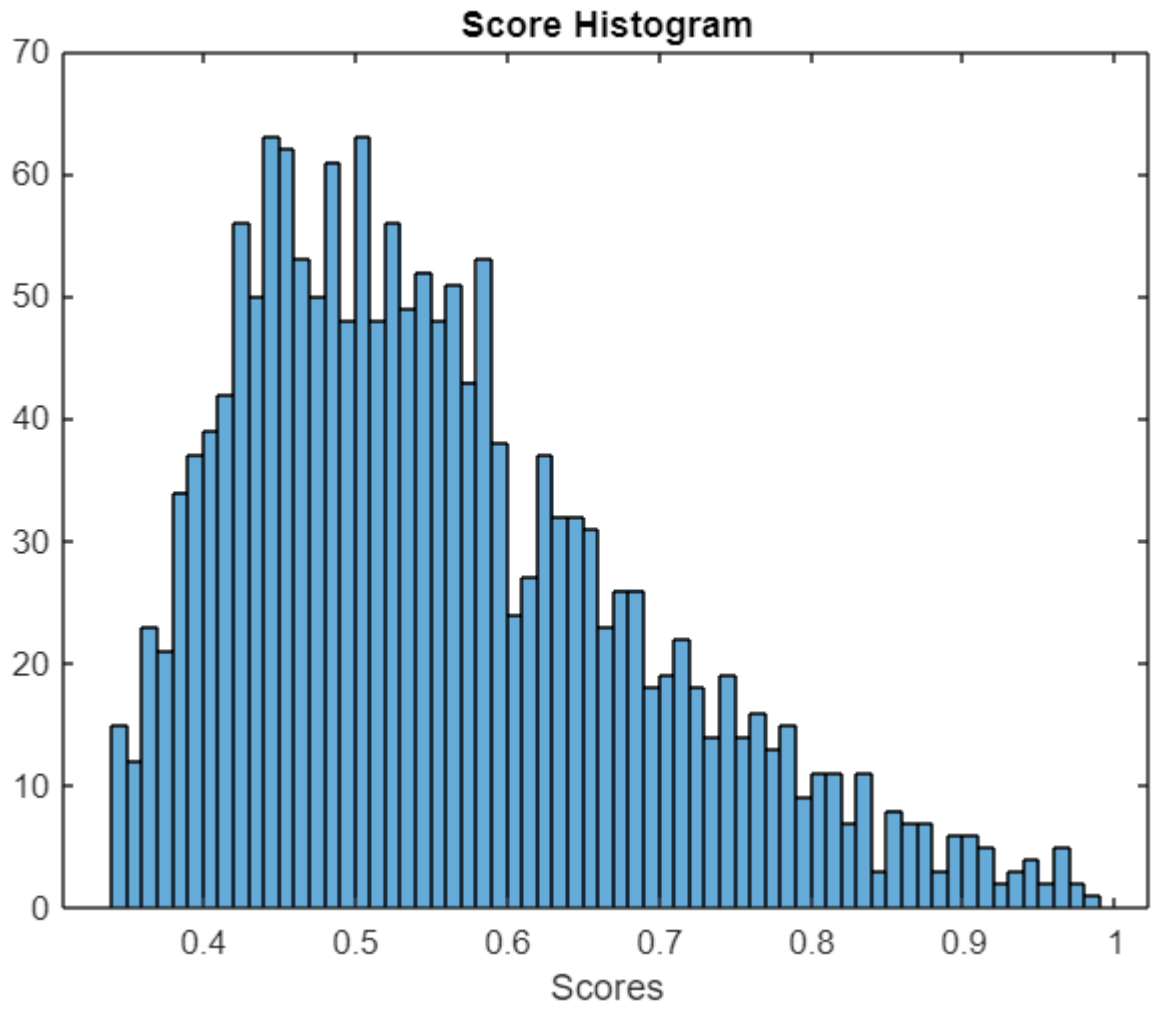
```
% gpuDevice(1);
% miniBatchSize=200;
% opts=trainingOptions("adam","Plots","training-
progress","ExecutionEnvironment","gpu", ...
%     "Shuffle","every-epoch","MiniBatchSize",miniBatchSize,"MaxEpochs",300,...
%
"InitialLearnRate",0.001,"LearnRateSchedule","piecewise","LearnRateDropPeriod",100,.
..."GradientThreshold",2,...
%     "OutputNetwork","best-validation-loss","ValidationData",
{v,X_Test.Labels},"ValidationFrequency",100,...
%     "ValidationPatience",20,"L2Regularization",.001);
% net=trainNetwork(y,X_Train.Labels,lgraph_1,opts);
```

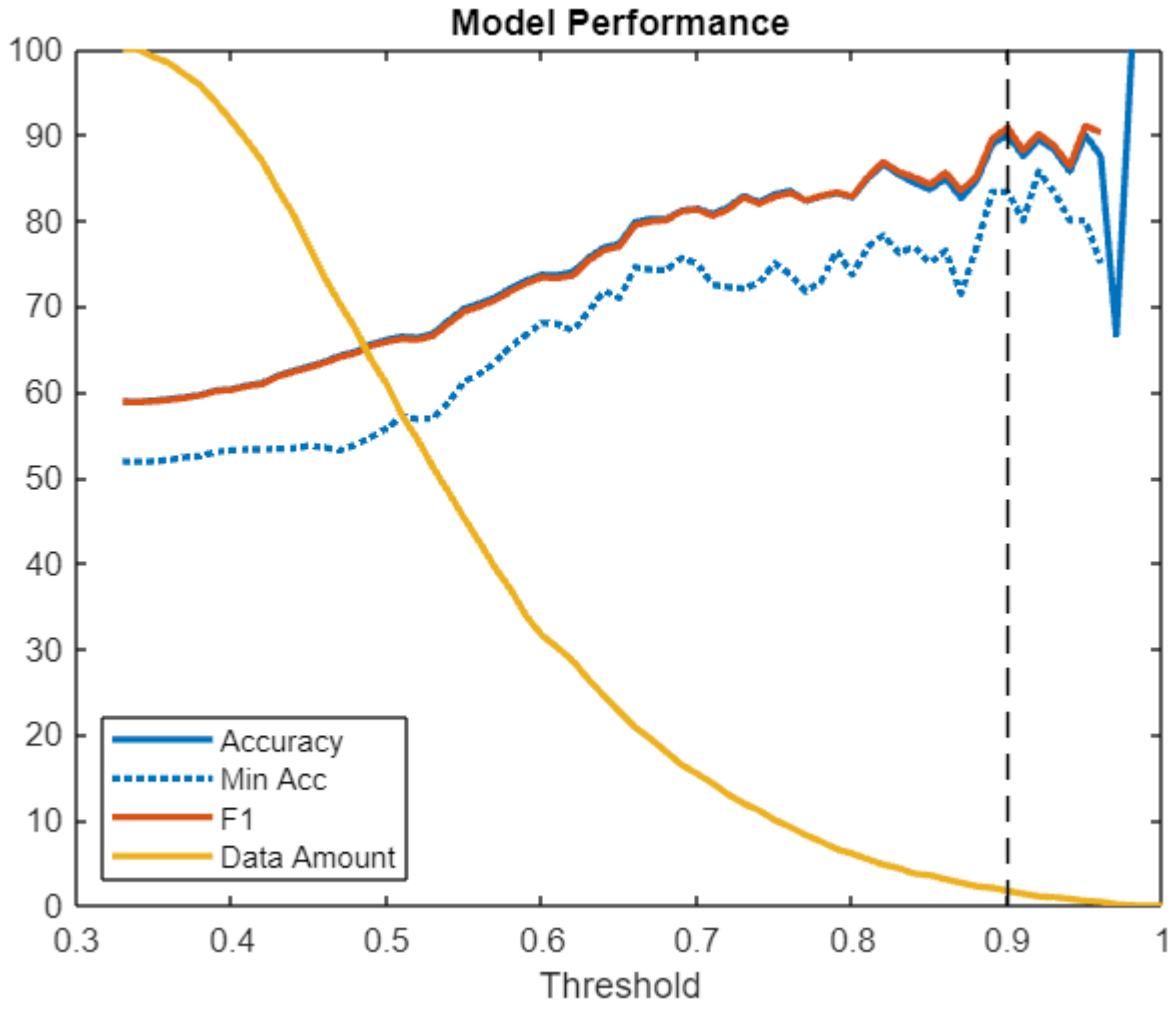
Basic Architecture

```
load("Topo_BasicNet.mat","net3")
basic3 = MdlResults(net3,v,X_Test.Labels);
classify(basic3);
```

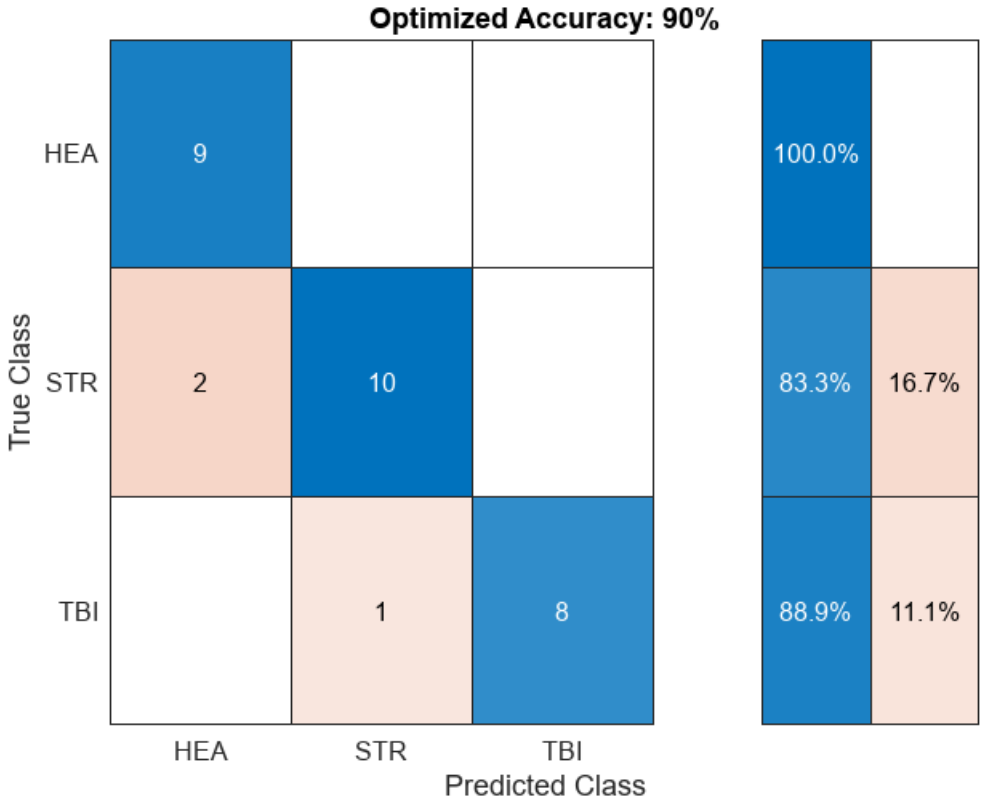


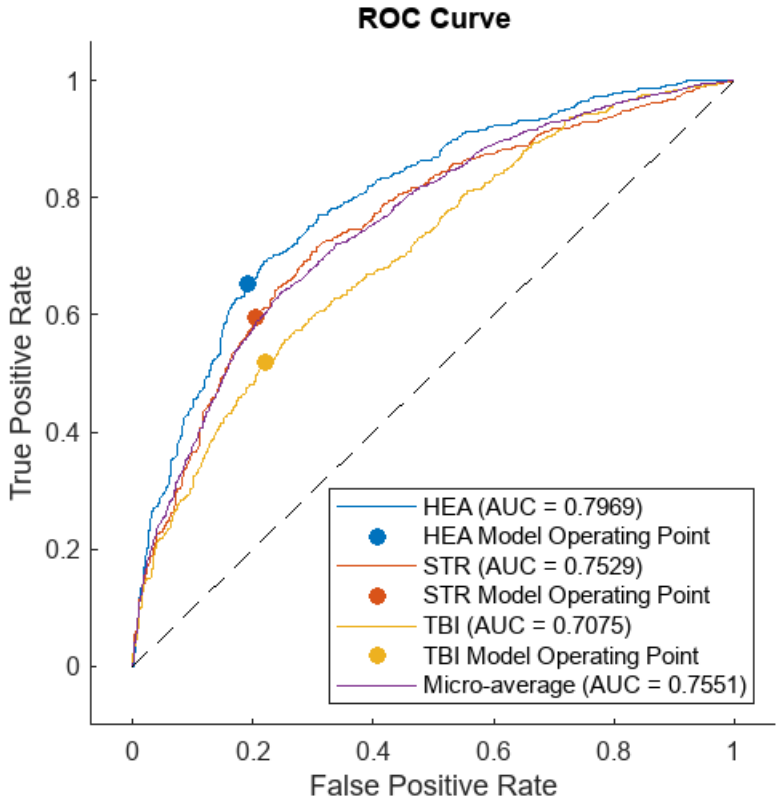

```
metrics(basic3);
```


Score Histogram
70
60
50
40
30
20
10
0
0.4
0.5
0.6
0.7
0.8
0.9
1
Scores




```
Data Remaining: 0.017575
```


Optimized Accuracy: 90%
HEA
STR
TBI
True Class
9
2
10
1
8
100.0%
83.3%
16.7%
88.9%
11.1%
HEA
STR
TBI
Predicted Class


ROC Curve
True Positive Rate
False Positive Rate
0
0.2
0.4
0.6
0.8
1
HEA (AUC = 0.7969)
HEA Model Operating Point
STR (AUC = 0.7529)
STR Model Operating Point
TBI (AUC = 0.7075)
TBI Model Operating Point
Micro-average (AUC = 0.7551)

Disclaimer