Detecting Malaria with CNN

How simple can it be?

Dataset: https://ceb.nlm.nih.gov/repositories/malaria-datasets/

```
clr
filepath = strcat(pwd, "\data_edited");
imds = imageDatastore(filepath, 'IncludeSubfolders',true,'LabelSource','foldernames');
```

Data exploration

```
labelCount = countEachLabel(imds);
subplot(1, 2, 1)
imshow(imds.Files{1})
title("No Malaria")


subplot(1, 2, 2)
imshow(imds.Files{13780})
title("Malaria")
disp(labelCount)
imSize = size(imread(imds.Files{1}));
numberOfLabels = length(unique(imds.Labels));
```

Train Test split

```
trainingSize = 0.75;
rng(1)
[trainData, testData] = splitEachLabel(imds, trainingSize, 'randomize');
```

Using the deep network designer to design my deep network

```
deepNetworkDesigner
```

Load network via mat file.

```
load("network_layers.mat")
```

```
options = trainingOptions('sgdm', 'MaxEpochs', 5, 'InitialLearnRate', 0.001);
CNN = trainNetwork(trainData, layers, options);
% save('malariaCNN.mat', 'CNN')
```

```
CNN = load("malariaCNN.mat");
CNN = CNN.CNN;
```

Result

```
close
```

```
[yTest, scores] = classify(CNN, testData);
tTest = testData.Labels;
accuracy = sum(yTest == tTest)/(numel(tTest));
disp(accuracy)
```
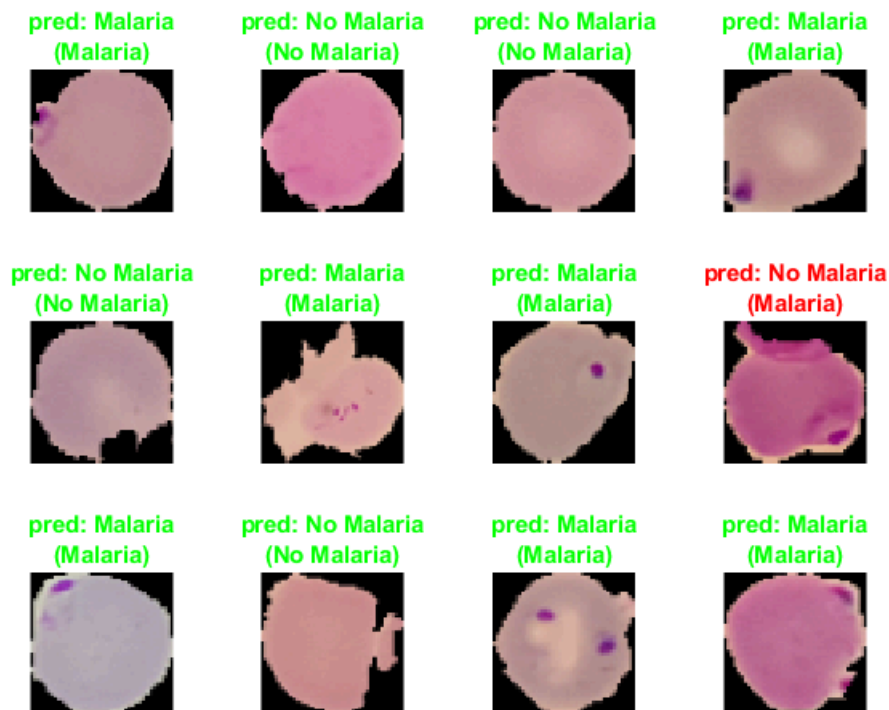
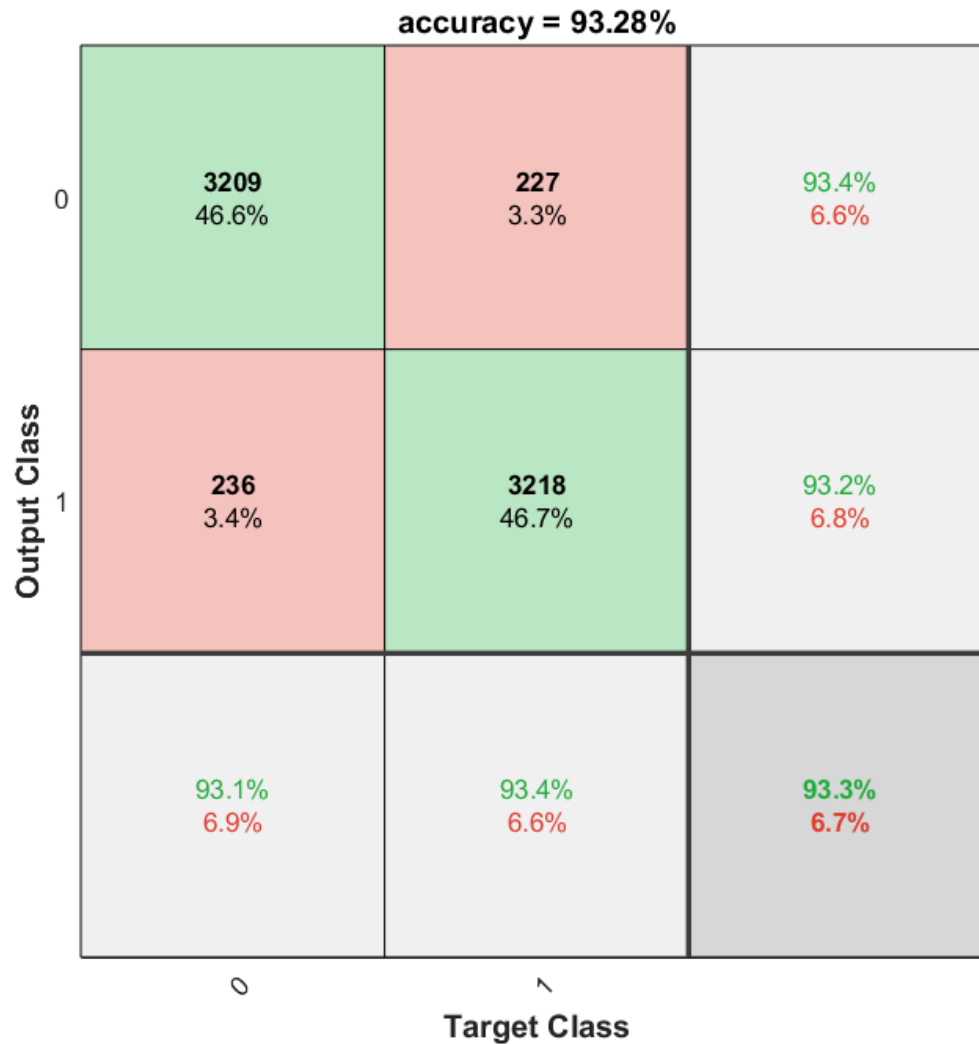0.9328

plot result

```
close all
labels = ["No Malaria", "Malaria"];
index = randperm(6890, 12);

for ii = 1:numel(index)
    I = readimage(testData, index(ii));
    pred = (yTest(index(ii)));
    label = tTest(index(ii));
    if label == pred
        color = 'g';
    else
        color = 'r';
    end

    subplot(3, 4, ii)
    imshow(I)
    title(sprintf("pred: %s\n(%s)", labels{pred}, labels{label}), "Color", color)
end
text(100, 20,sprintf("accuracy = %0.2f%%", accuracy*100));
```
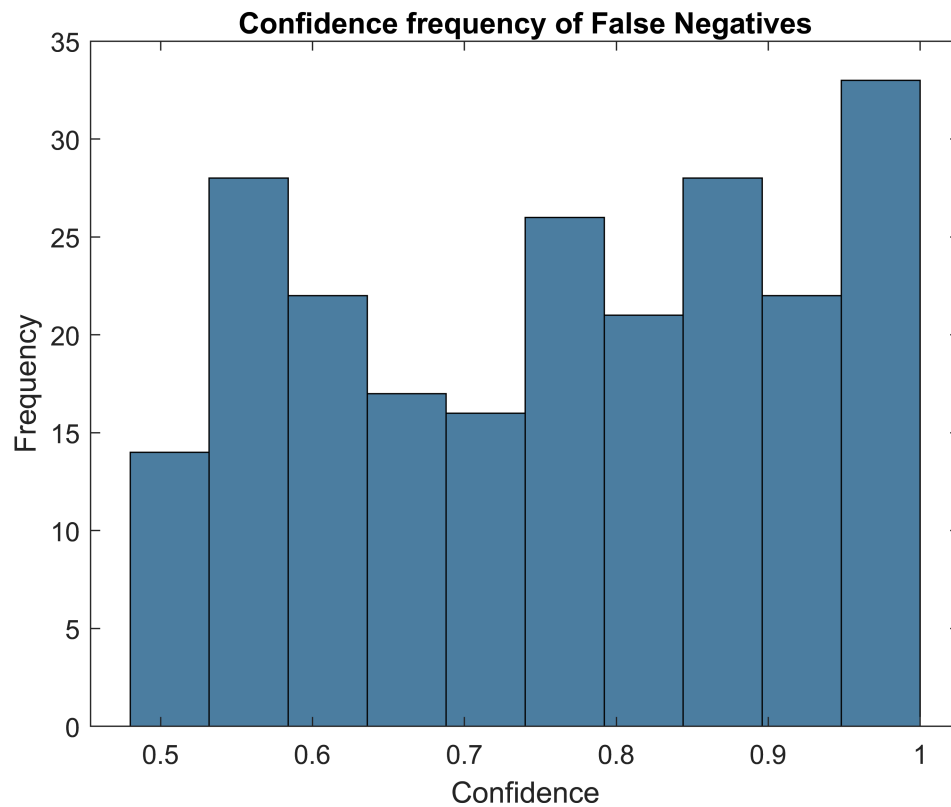
```
figure("Color","w");
plotconfusion(tTest, yTest);
title(sprintf("accuracy = %0.2f%%", accuracy*100));
```


accuracy = 93.28%

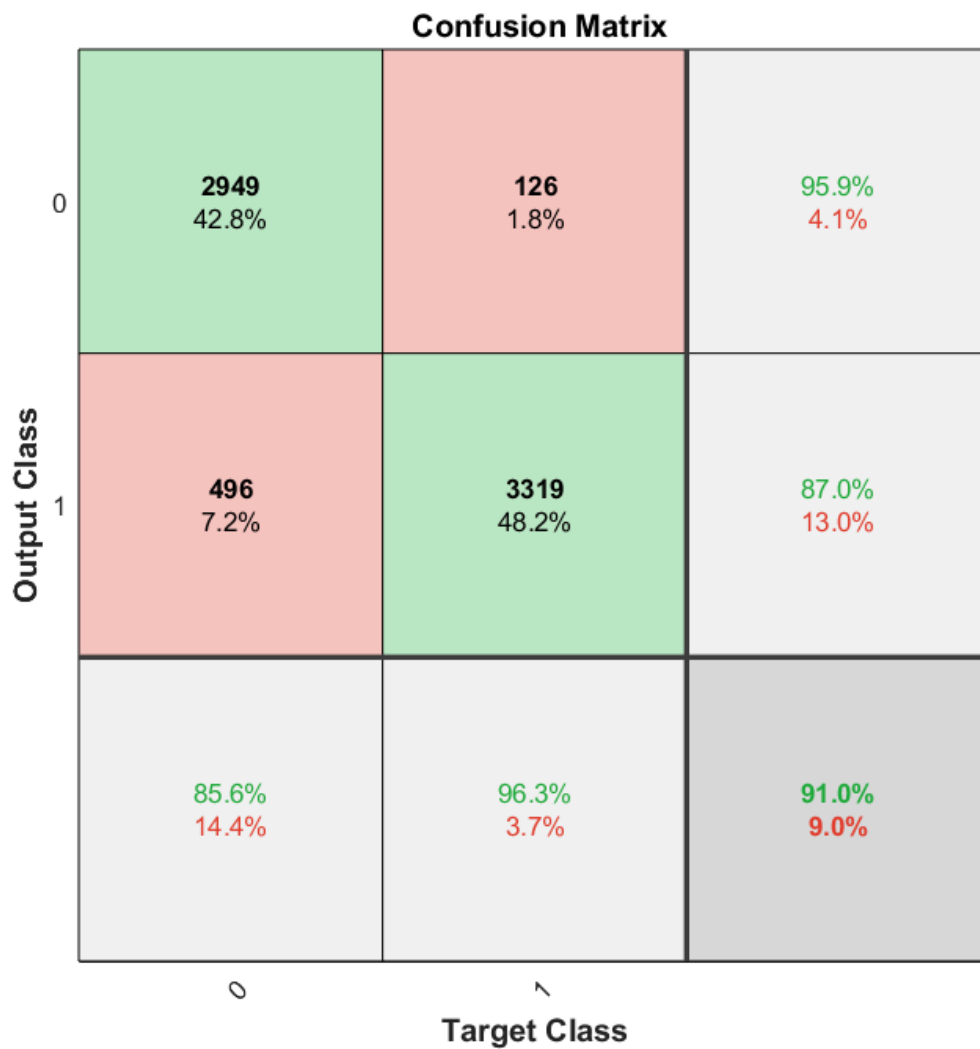|	0	1	
0	**3209** 46.6%	**227** 3.3%	93.4% 6.6%
1	**236** 3.4%	**3218** 46.7%	93.2% 6.8%
	93.1% 6.9%	93.4% 6.6%	**93.3%** **6.7%**

Output Class

Target Class

```
clf
histogram(scores(tTest == "1" & yTest == "0", 1), 10);
title("Confidence frequency of False Negatives")
xlabel("Confidence")
ylabel("Frequency")
```

Confidence frequency of False Negatives

```
editScores = scores;
threshold = 0.75;
underThresh = scores(:, 1) < threshold & scores(:, 1) > 0.50;
editScores(underThresh, 1) = editScores(underThresh, 1) - 0.50;
[M, I] = max(editScores, [], 2);
yTest2 = I-1;
yTest2 = categorical(yTest2);
accuracy2 = sum(yTest2 == tTest)/(numel(tTest))
```

accuracy2 = 0.9097

```
figure("Color","w");
plotconfusion(tTest, yTest2);
```

Confusion Matrix

	Target Class: 0	**Target Class: 1**	
Output Class: 0	**2949** / 42.8%	**126** / 1.8%	95.9% / 4.1%
Output Class: 1	**496** / 7.2%	**3319** / 48.2%	87.0% / 13.0%
	85.6% / 14.4%	96.3% / 3.7%	**91.0%** / **9.0%**

```
figure;
ax1 = subplot(2, 1, 1);
hist2 = histogram(editScores(tTest == "1" & yTest2 == "0", 1), "BinWidth",0.05);
title("New")

ax2 = subplot(2, 1, 2);
hist = histogram(scores(tTest == "1" & yTest == "0", 1), "BinWidth",0.05);
axis([0 1 0 35])
title("Old")
xlabel("Confidence")
linkaxes([ax1,ax2],'xy')
```

New

Old

Confidence