Are the Roundworms Alive or Dead?

Uses Transfer learning to train a deep network that can classify images of roundworms as either alive or dead. (Alive worms are round; dead ones are straight.)

Get the training images and classes

Create a datastore to the images.Specify the datastore where the Downloaded Folder is.

```
imds = imageDatastore('/home/akash/Downloads/deeplearning_course_files/Roundworms/WormI
```

Get the known classifications from a file and use these as the image labels.

```
groundtruth = readtable('WormData.csv');
```

groundtruth = 93×2 table

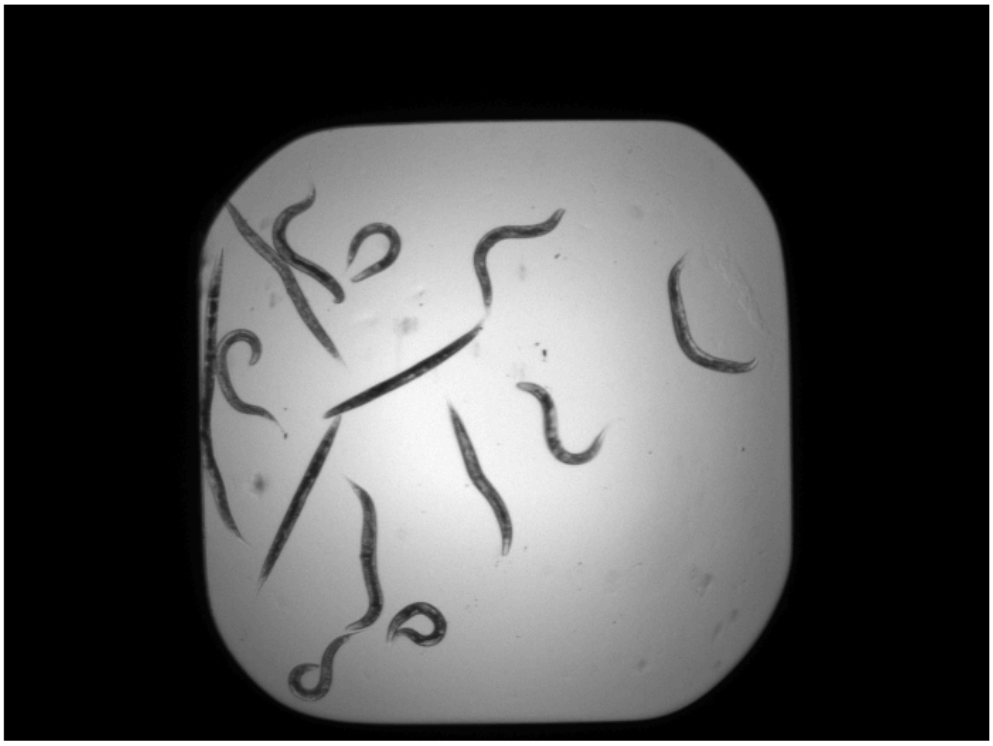
	File	Status
1	'wormA01.tif'	'alive'
2	'wormA02.tif'	'alive'
3	'wormA03.tif'	'alive'
4	'wormA04.tif'	'alive'
5	'wormA05.tif'	'alive'
6	'wormA06.tif'	'alive'
7	'wormA07.tif'	'alive'
8	'wormA08.tif'	'alive'
9	'wormA09.tif'	'alive'
10	'wormA10.tif'	'alive'
11	'wormA11.tif'	'alive'
12	'wormA12.tif'	'alive'
13	'wormA13.tif'	'dead'
14	'wormA14.tif'	'dead'

⋮

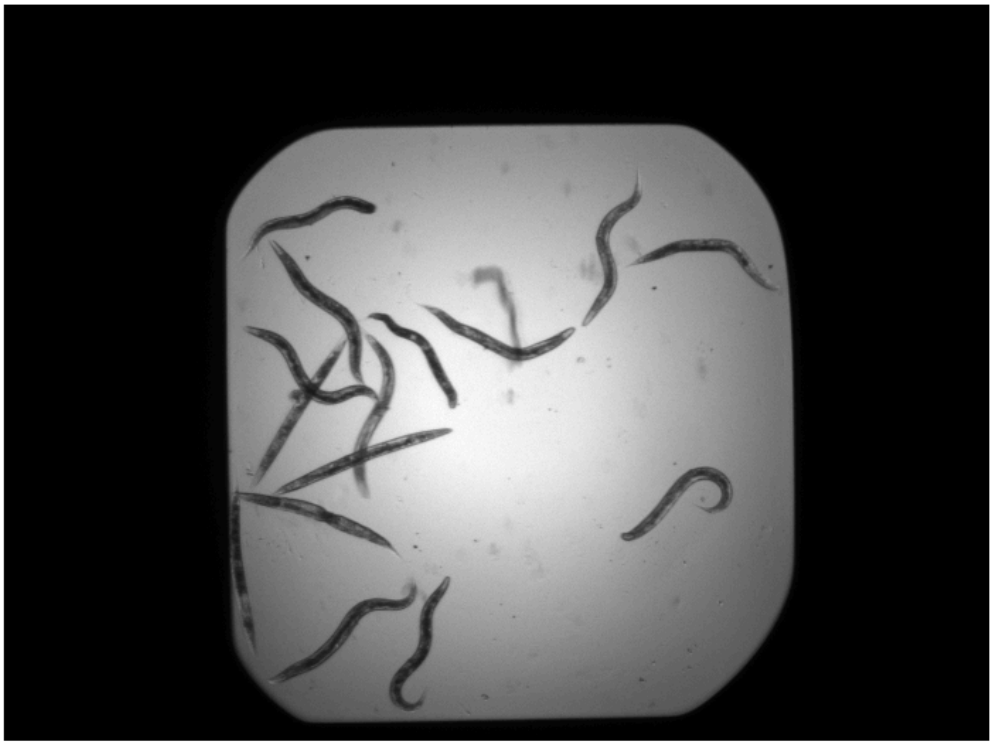
```
imds.Labels = categorical(groundtruth.Status);%Attach labels to the image datastore, st
```

View the first few images. The second argument to `imshow` scales the display based on the range of pixel values in the image.

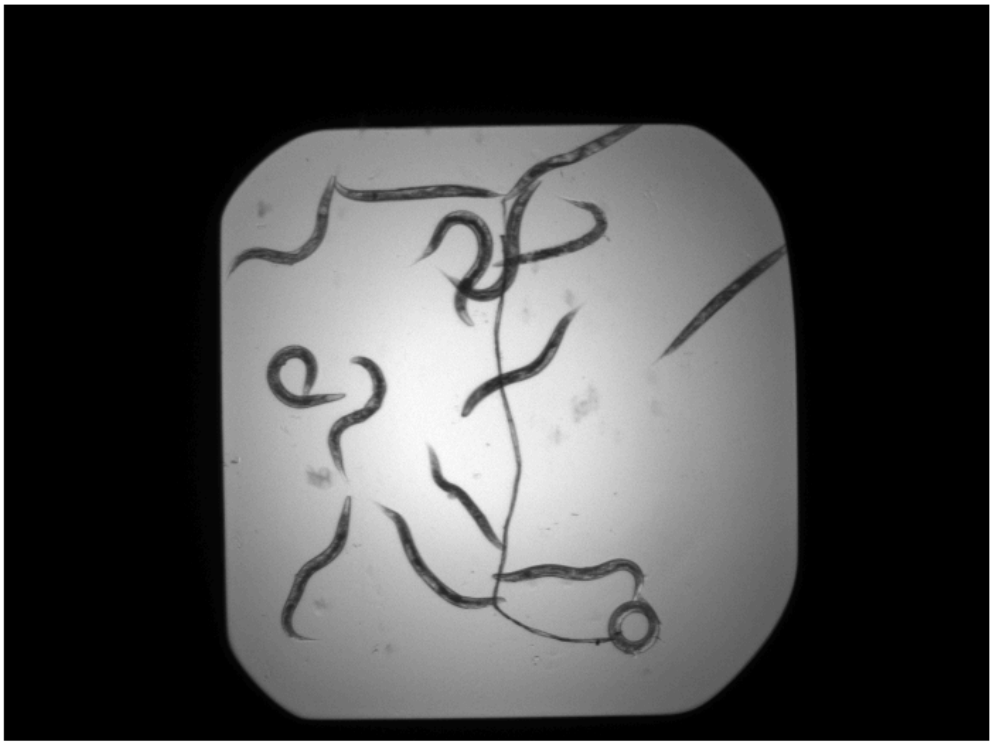
```
imshow(readimage(imds,1),[])% View the documentation of 'imshow' for more info
```



```
imshow(readimage(imds,2),[])
```



```
imshow(readimage(imds,3),[])
```



Divide data into training (60%) and testing (40%) sets

```
[trainImgs,testImgs] = splitEachLabel(imds,0.6,'randomized');
```

Create augmented image datastores to preprocess the images.

```
trainds = augmentedImageDatastore([227 227],trainImgs,'ColorPreprocessing','gray2rgb');
testds = augmentedImageDatastore([227 227],testImgs,'ColorPreprocessing','gray2rgb');
```

Build a network

Start with a pretrained network

```
net = alexnet;
```

Take the CNN layers and add new classification layers at the end.

```
prebuiltLayers = net.Layers(1:end-3);
layers = [prebuiltLayers;fullyConnectedLayer(2);softmaxLayer;classificationLayer];
```

Set some training options

```
topts = trainingOptions('adam','InitialLearnRate',0.0001);
```

Train the network

```
wormsnet = trainNetwork(trainds,layers,topts)% One can change training parameters
```

```
Training on single CPU.
Initializing input data normalization.
|=========================================================================================|
|  Epoch  |  Iteration  |  Time Elapsed  |  Mini-batch  |  Mini-batch  |  Base Learning  |
|         |             |   (hh:mm:ss)   |   Accuracy   |     Loss     |      Rate       |
|=========================================================================================|
|       1 |           1 |       00:00:22 |       44.64% |       2.4804 |      1.0000e-04 |
|      30 |          30 |       00:09:18 |      100.00% |   1.0005e-07 |      1.0000e-04 |
|=========================================================================================|
wormsnet =
  SeriesNetwork with properties:

         Layers: [25×1 nnet.cnn.layer.Layer]
     InputNames: {'data'}
    OutputNames: {'classoutput'}
```

Evaluate network on test data

Make predictions

```
preds = classify(wormsnet,testds);
```

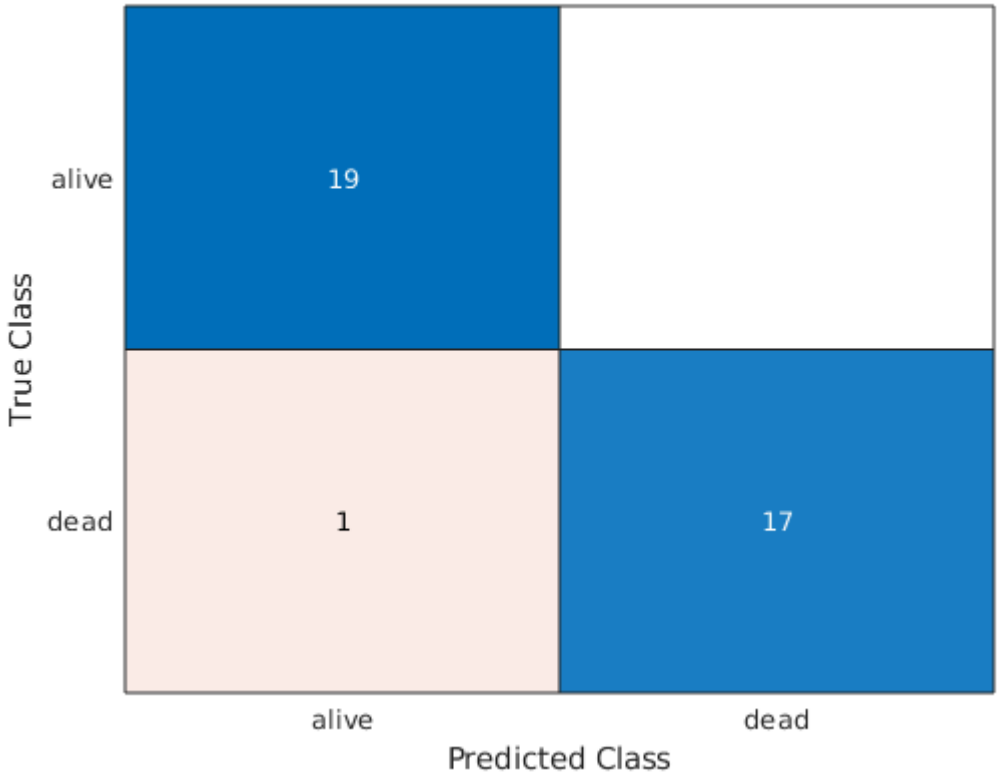
Compare with reality

```
truetest = testImgs.Labels;
nnz(preds == truetest)/numel(preds)
```

```
ans = 0.9730
```

View confusion matrix

```
confusionchart(truetest,preds);
```


alive
dead
True Class
19
1
17
alive
dead
Predicted Class