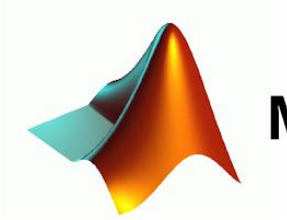
Matlab Deep Learning



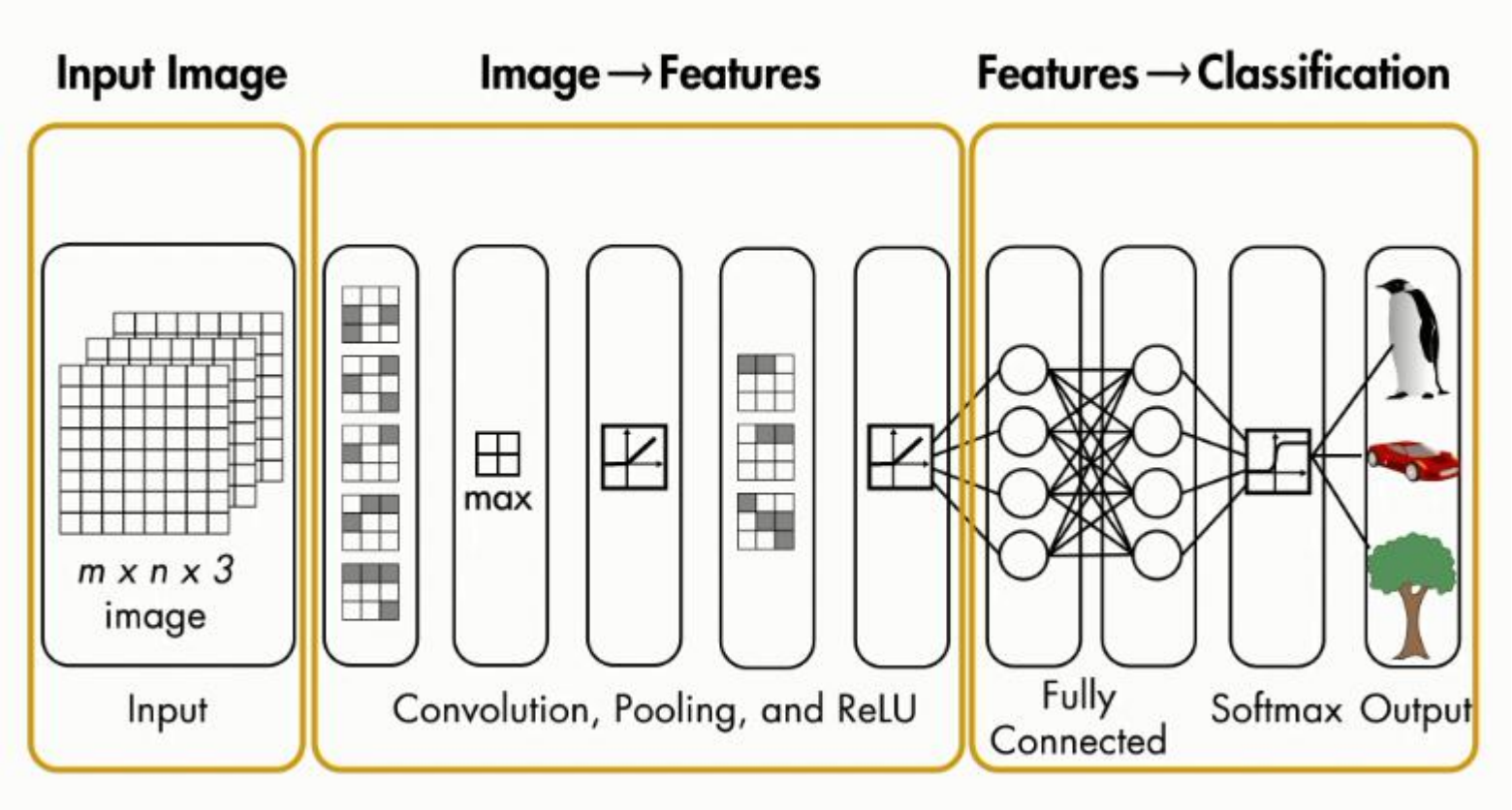
MATLAB

>>> WHY USE MATLAB?

- Matlab Deep Learning Toolbox implements a framework for composing and performing deep neural networks with algorithms, trained models, and applications.
- A user can apply convolutional neural networks and long short-term memory (LSTM) networks to provide classification and regression on image, time-series, and text data.
- deepNetworkDesigner and experimentManager Apps support users to visualize or edit network architectures, and monitor training progress.

>>> Outline

>>> Introduction



>>> What Kind of Flower is That?

This example uses transfer learning to train a deep network that can classify images of flowers into one of 12 species.




>>> Get training images

```
flowerds = imageDatastore("Flowers","IncludeSubfolders",true,...
                          "LabelSource","foldernames");
```

Split into training and testing sets

```
[trainImgs,testImgs] = splitEachLabel(flowerds,0.6);
```

Determine the number of flower species

```
numClasses = numel(categories(flowerds.Labels));
```

>>> Create a network by modifying GoogLeNet

Get the layers from GoogLeNet

```
net = googlenet;
lgraph = layerGraph(net)
```

Modify the classification and output layers

```
newFc = fullyConnectedLayer(numClasses,"Name","new_fc")
lgraph = replaceLayer(lgraph,"loss3-classifier",newFc)
newOut = classificationLayer("Name","new_out")
lgraph = replaceLayer(lgraph,"output",newOut)
```

>>> Set training algorithm options

Lower the learning rate for transfer learning

```
options = trainingOptions("sgdm","InitialLearnRate", 0.001);
```

Perform training

```
[flowernet,info] = trainNetwork(trainImgs, lgraph, options);
```

Use the trained network to classify test images

```
testpreds = classify(flowernet,testImgs);
```

>>> Training Process

```
Training on single GPU.
Initializing input data normalization.
|=========================================================================================|
|  Epoch  |  Iteration  |  Time Elapsed  |  Mini-batch  |  Mini-batch  |  Base Learning  |
|         |             |   (hh:mm:ss)   |   Accuracy   |     Loss     |      Rate       |
|=========================================================================================|
|       1 |           1 |       00:00:02 |        7.03% |       4.6878 |          0.0010 |
|      13 |          50 |       00:00:44 |       96.88% |       0.0968 |          0.0010 |
|      25 |         100 |       00:01:27 |      100.00% |       0.0167 |          0.0010 |
|      30 |         120 |       00:01:45 |       98.44% |       0.0352 |          0.0010 |
|=========================================================================================|
```

>>> Evaluate the results

Calculate the accuracy

```
nnz(testpreds == testImgs.Labels)/numel(testpreds)
% ans = 0.9141
```

Visualize the confusion matrix

```
confusionchart(testImgs.Labels,testpreds);
```

>>> Confusion Matrix