

MATLAB EXPO 2017

KOREA

4월 27일, 서울

등록 하기 matlabexpo.co.kr

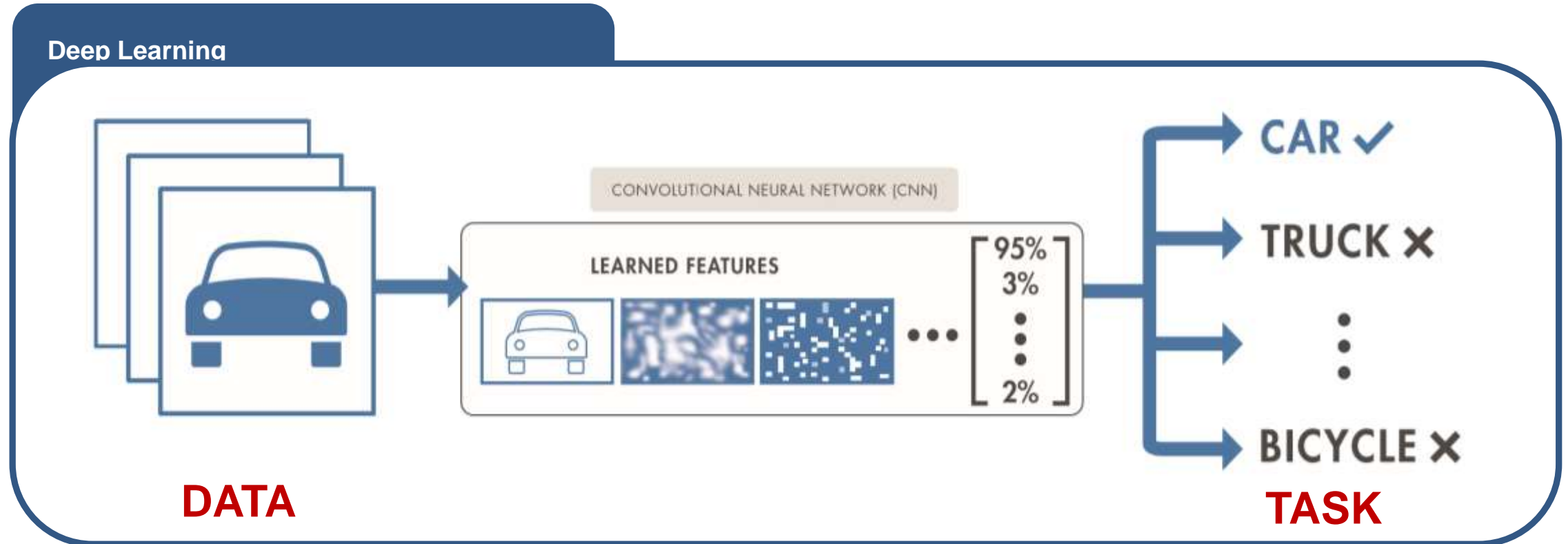
딥러닝 기반 응용 프로그램 작성 기법

Application Engineer

엄준상 과장

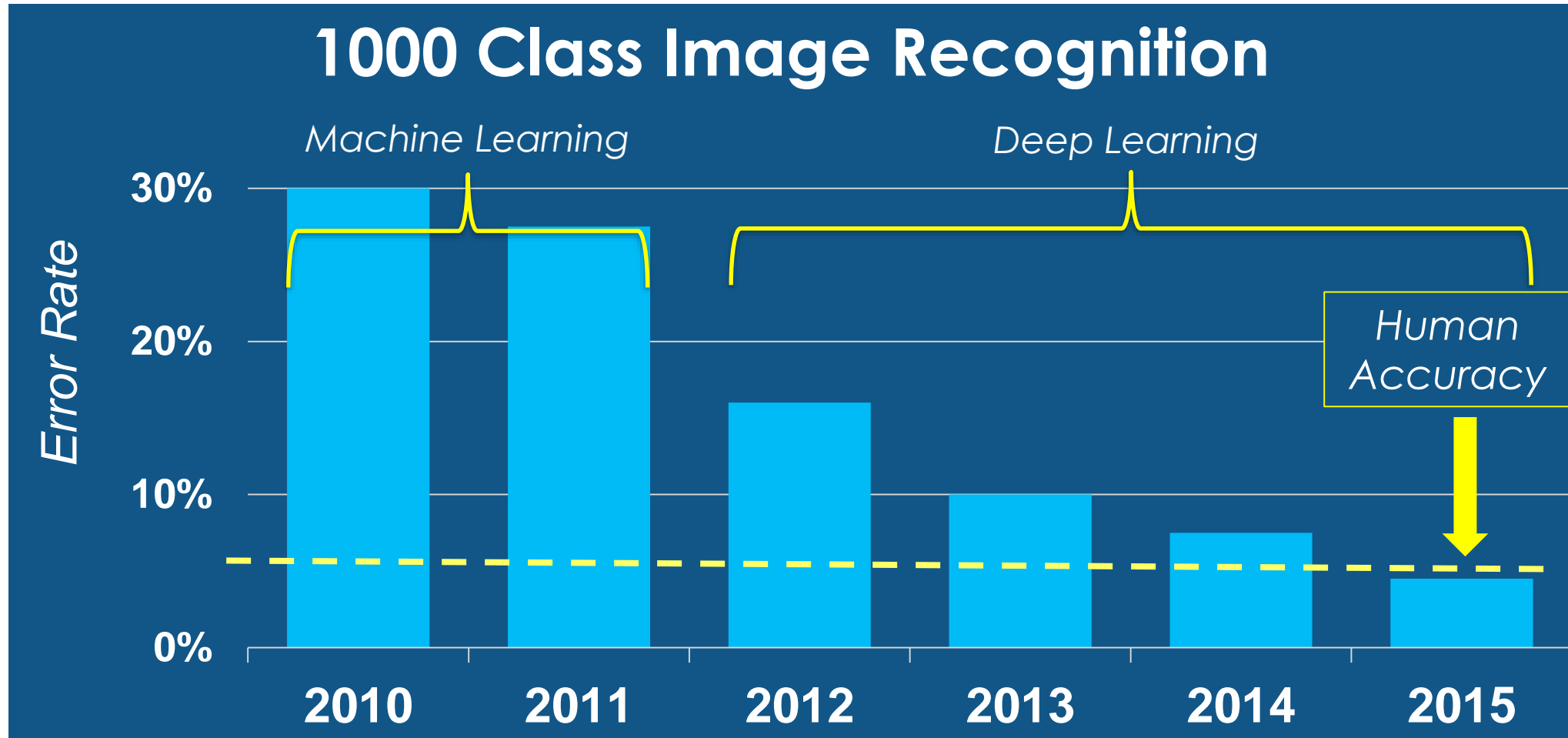
What is Deep Learning ?

Deep learning is a **type of machine learning** that performs **end-to-end learning** by learning **tasks** directly from **images, text, and sound**.



Why is Deep Learning So Popular Now?

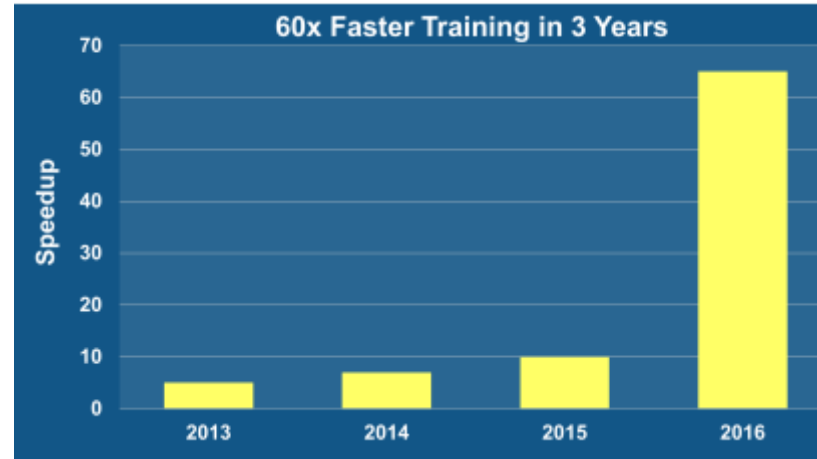
Unparalleled Accuracy



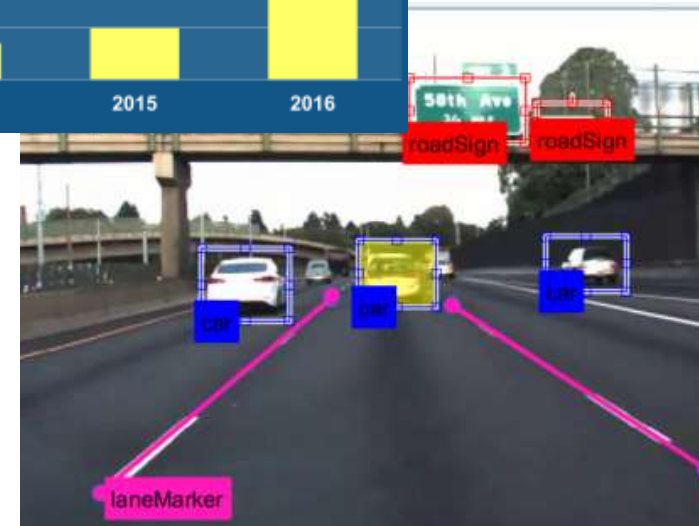
Source: ILSVRC Top-5 Error on ImageNet

Deep Learning Enablers

Acceleration with GPU's



Massive sets of labeled data

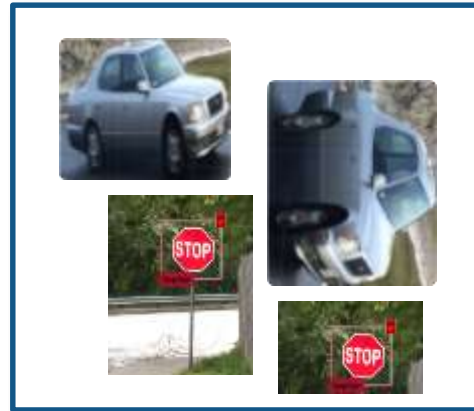
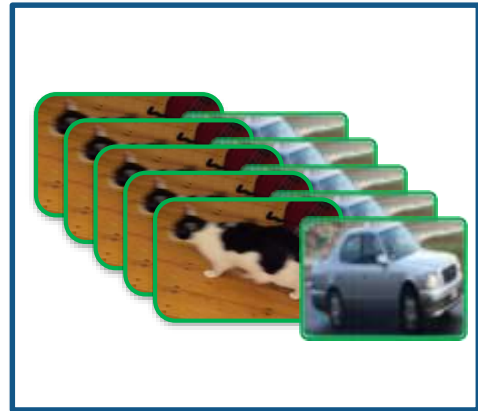


Availability of state of the art models from experts



Deep Learning Workflow

✓ Leverages MATLAB Platform Strengths



Access & Explore

Preprocess Data

Develop Predictive Models

Integrate Analytics to Systems

Training Data

- Large open datasets
- Recorded labeled data (e.g., images, video)

Pre-Trained Models

- Access state-of-art networks already trained on large datasets

Data Augmentation

- Crop, resize and rotate images – create more training data

Label Training Data

- For image data: draw ROI's, label individual pixels with labels

Train from Scratch

- Configure and train a deep network with massive amount of training data

Transfer Learning

- Tune pre-trained model for a different task with smaller datasets

Share Models

- Publish models for others to use

Embedded Deployment

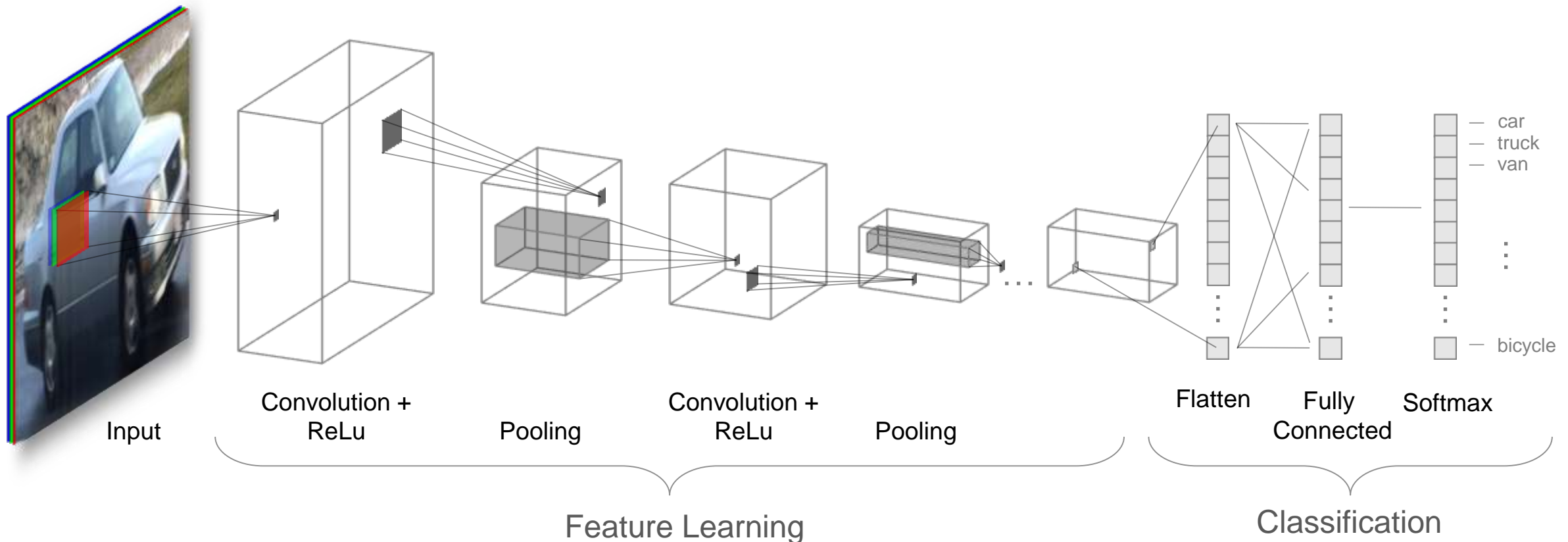
- Embedded processors
- FPGA

HPC

- Servers (multi-GPU)
- Clusters

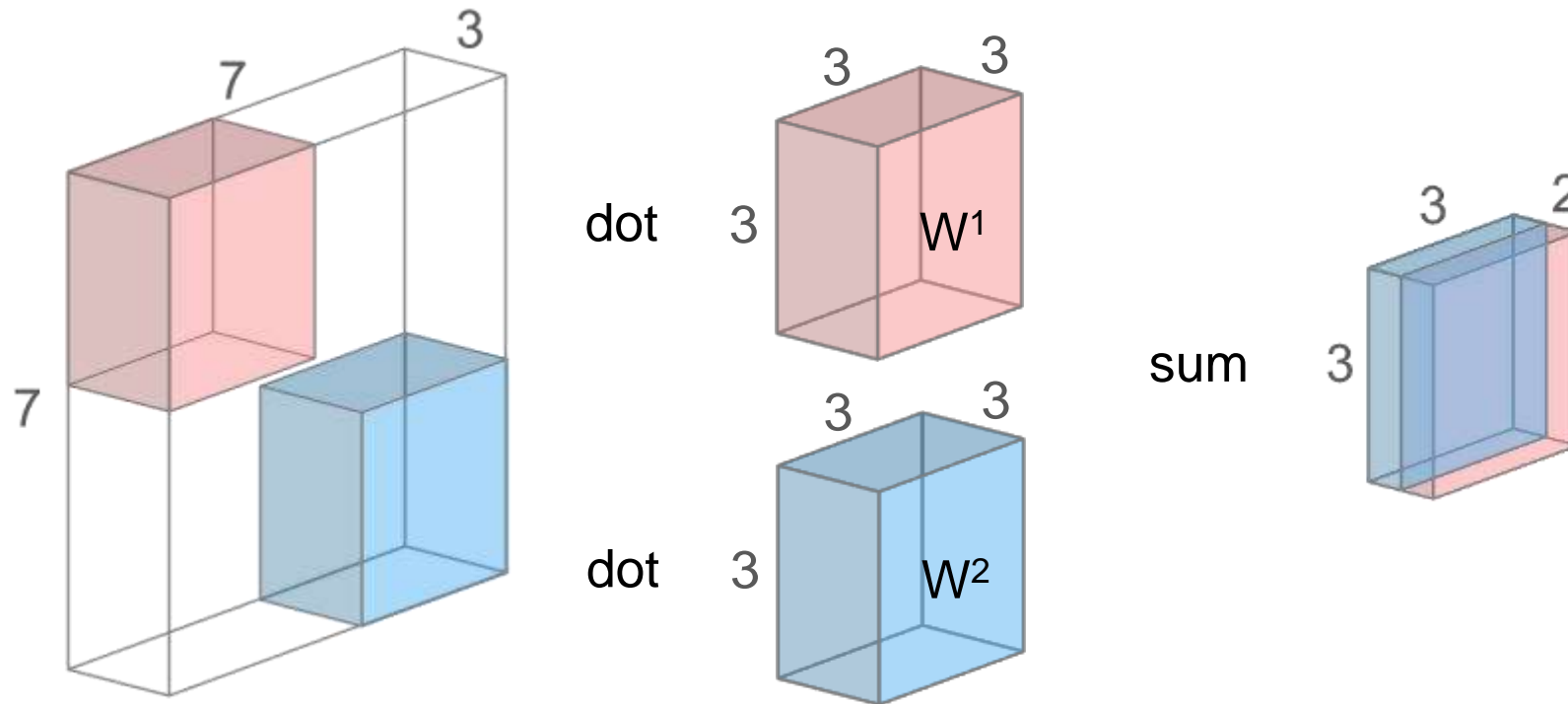
Convolutional Neural Networks

- Train “deep” neural networks on structured data (e.g. images, signals, text)
- Implements Feature Learning: Eliminates need for “hand crafted” features
- Trained using GPUs for performance



Convolution Layer

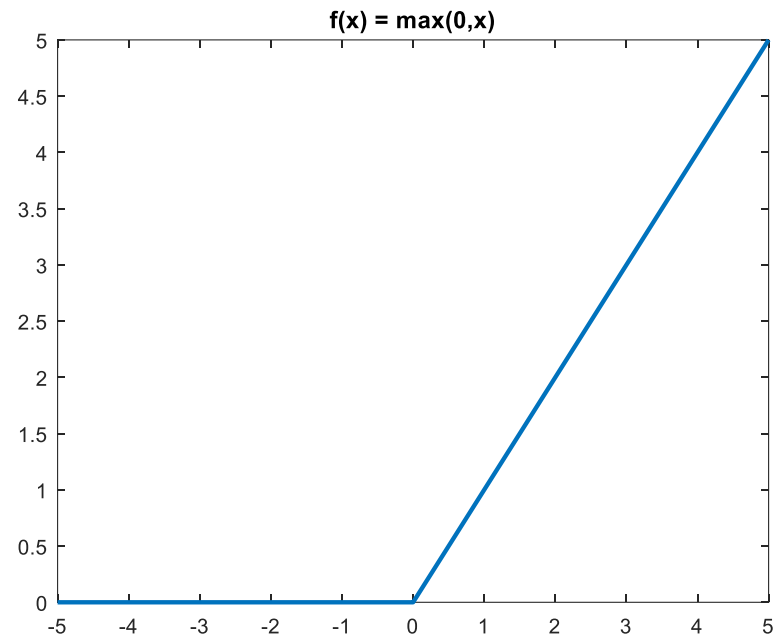
- Core building block of a CNN
- Convolve the filters sliding them across the input, computing the dot product



- Intuition: learn filters that activate when they “see” some specific feature

Rectified Linear Unit (ReLU) Layer

- Frequently used in combination with Convolution layers
- Do not add complexity to the network
- Most popular choice: $f(x) = \max(0, x)$, activation is thresholded at 0



Pooling Layer

- Perform a **downsampling** operation across the spatial dimensions
- Goal: progressively decrease the size of the layers
- Max pooling and average pooling methods
- Popular choice: Max pooling with 2x2 filters, Stride = 2

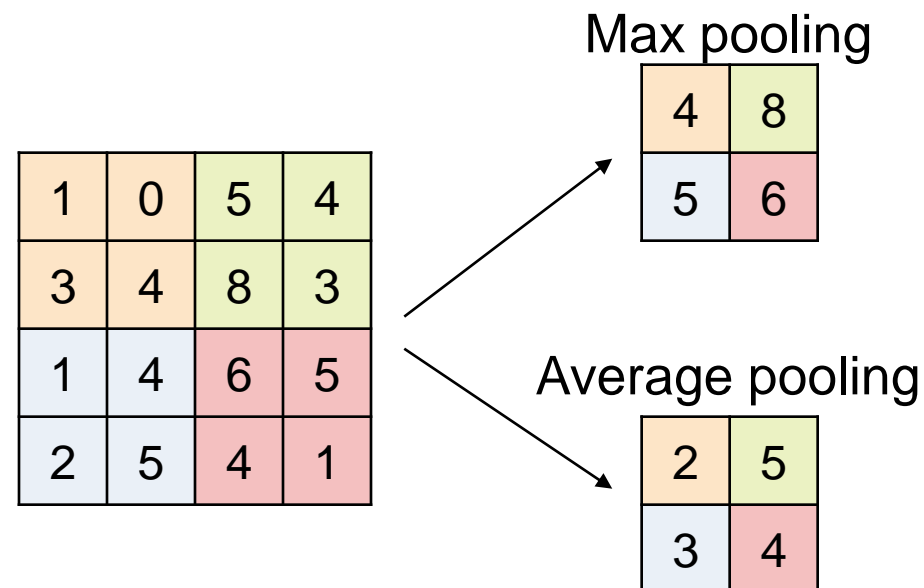
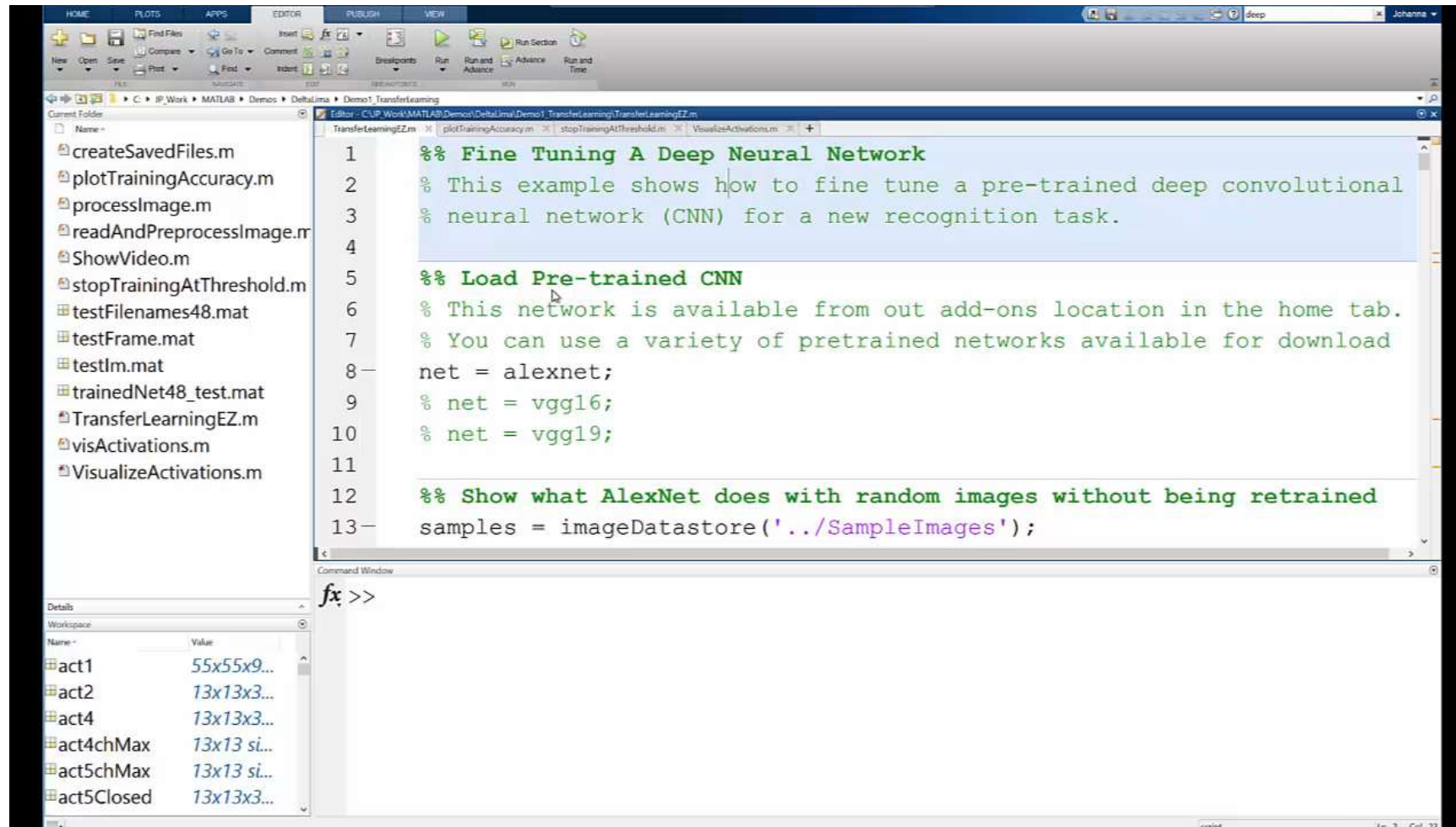


Image Classification Using Pre-trained Network (Video)

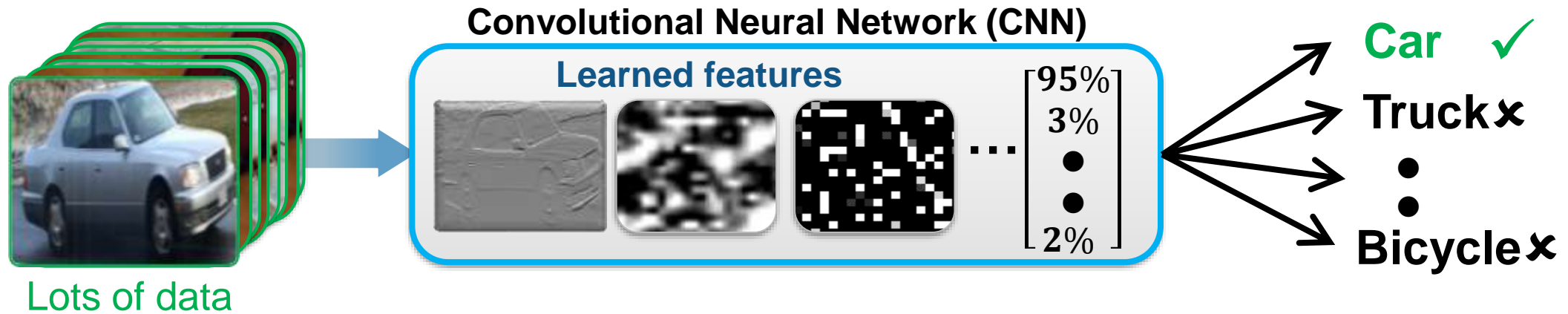


```
1  %% Fine Tuning A Deep Neural Network
2  % This example shows how to fine tune a pre-trained deep convolutional
3  % neural network (CNN) for a new recognition task.
4
5  %% Load Pre-trained CNN
6  % This network is available from our add-ons location in the home tab.
7  % You can use a variety of pretrained networks available for download
8  net = alexnet;
9  % net = vgg16;
10 % net = vgg19;
11
12 %% Show what AlexNet does with random images without being retrained
13 samples = imageDatastore('.../SampleImages');
```

Name	Value
act1	55x55x9...
act2	13x13x3...
act4	13x13x3...
act4chMax	13x13 si...
act5chMax	13x13 si...
act5Closed	13x13x3...

Approaches for Deep Learning

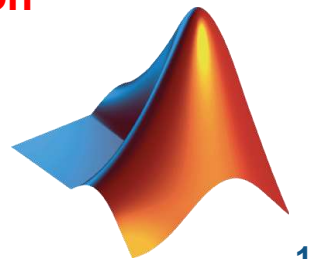
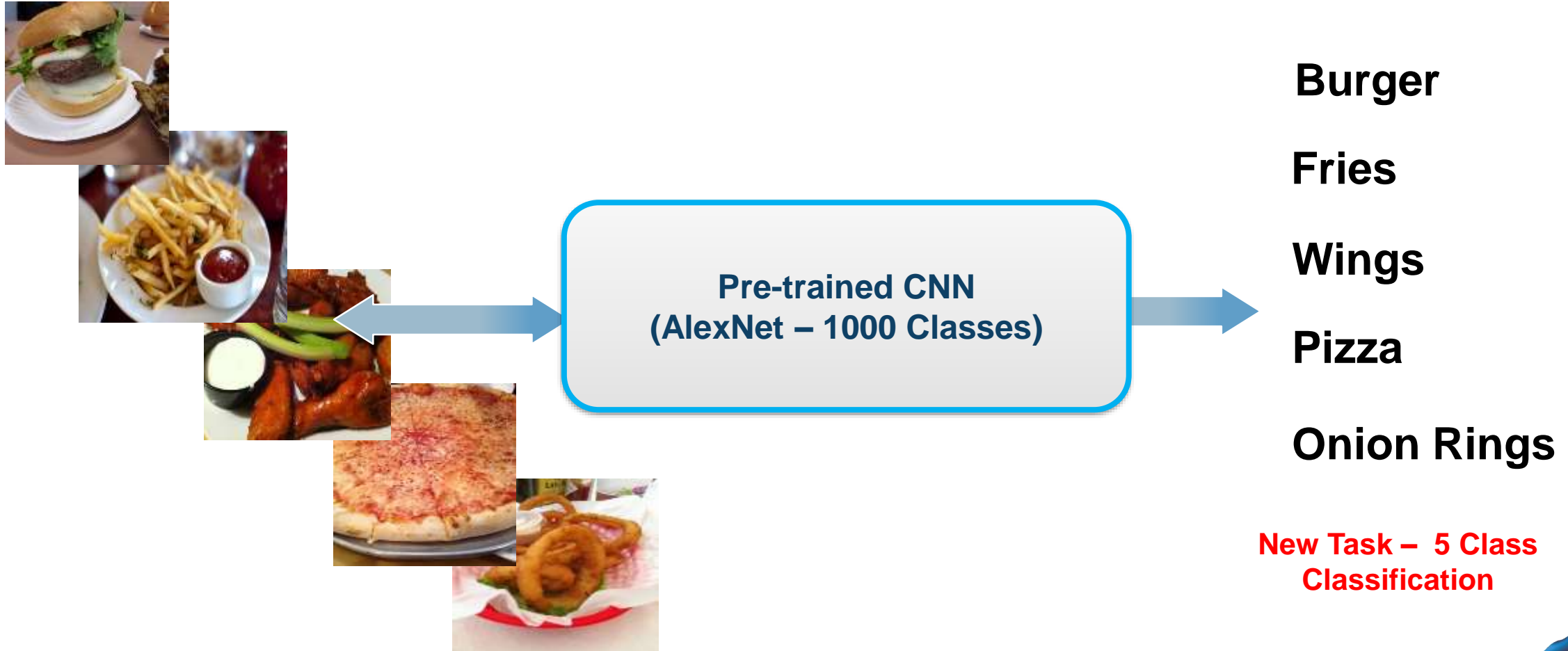
1. Train a Deep Neural Network from Scratch



2. Fine-tune a pre-trained model (transfer learning)



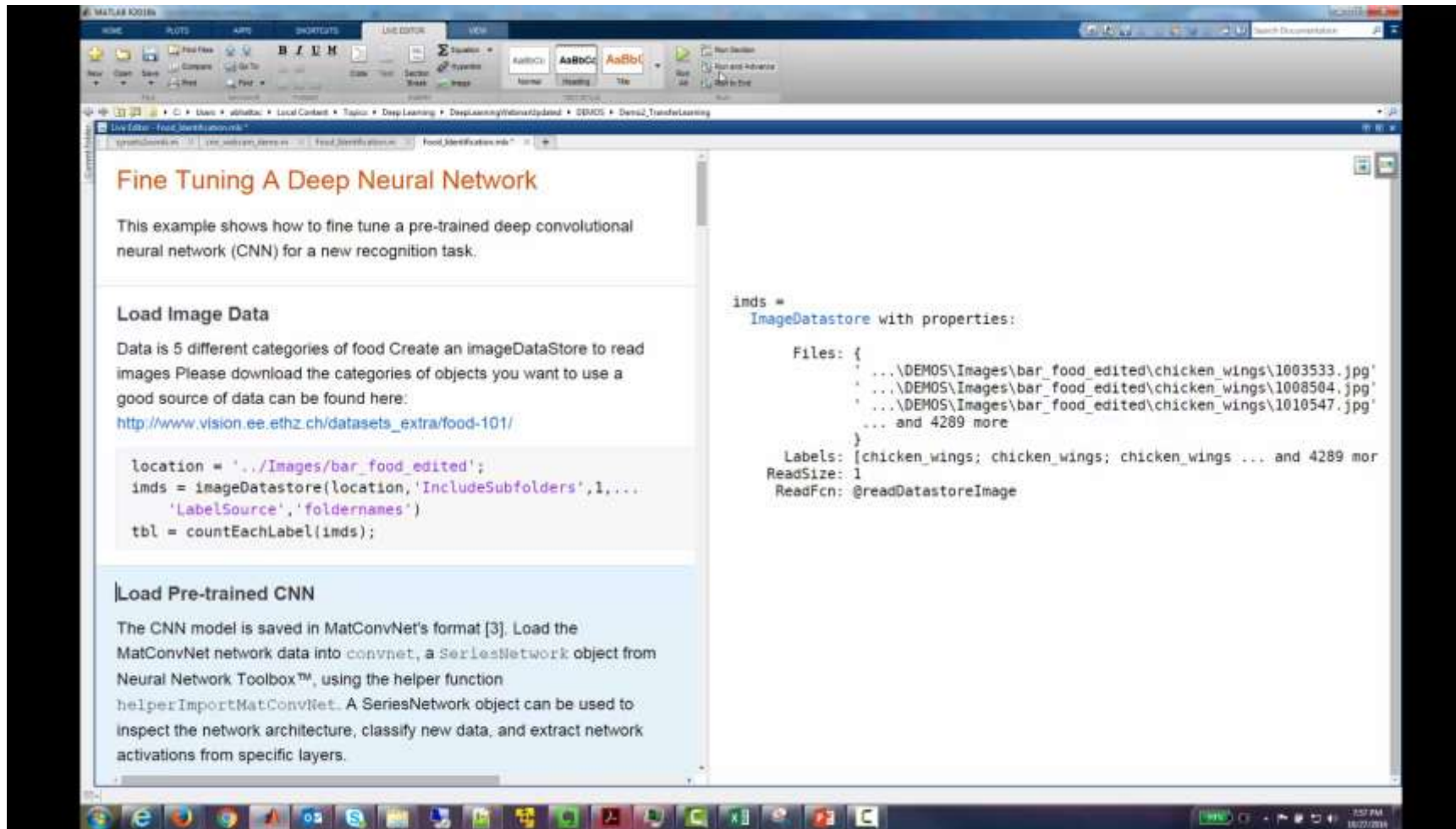
Example: Fine-tune a pre-trained model (Transfer learning)



Why Perform Transfer Learning

- Requires less data and training time
- Reference models (like AlexNet, VGG-16, VGG-19) are great feature extractors
- Leverage best network types from top researchers

Transfer Learning in MATLAB



The image shows a MATLAB Live Editor window titled "Fine Tuning A Deep Neural Network". The window is divided into two main sections: a text-based tutorial on the left and a code editor on the right.

Fine Tuning A Deep Neural Network

This example shows how to fine tune a pre-trained deep convolutional neural network (CNN) for a new recognition task.

Load Image Data

Data is 5 different categories of food Create an imageDatastore to read images Please download the categories of objects you want to use a good source of data can be found here:
http://www.vision.ee.ethz.ch/datasets_extra/food-101/

```
location = '../Images/bar_food_edited';
inds = imageDatastore(location, 'IncludeSubfolders', 1, ...
    'LabelSource', 'foldernames');
tbl = countEachLabel(inds);
```

Load Pre-trained CNN

The CNN model is saved in MatConvNet's format [3]. Load the MatConvNet network data into `convnet`, a `SeriesNetwork` object from Neural Network Toolbox™, using the helper function `helperImportMatConvNet`. A `SeriesNetwork` object can be used to inspect the network architecture, classify new data, and extract network activations from specific layers.

```
inds =
    ImageDatastore with properties:
        Files: {
            '...\DEMOS\Images\bar_food_edited\chicken_wings\1003533.jpg'
            '...\DEMOS\Images\bar_food_edited\chicken_wings\1008504.jpg'
            '...\DEMOS\Images\bar_food_edited\chicken_wings\1010547.jpg'
            ... and 4289 more
        }
        Labels: [chicken_wings; chicken_wings; chicken_wings ... and 4289 mor
        ReadSize: 1
        ReadFcn: @readDatastoreImage
```

Manipulate Deep Learning Networks Easily

Perform net surgery

Modify the existing network by deleting later layers and adding new ones.

```
% Here we only need to keep everything except the last 3 layers.
```

```
layers = net.Layers(1:end-3)
```

DELETE LAYERS

```
% Add new fully connected layer for 2 categories.
```

```
layers(end+1) = fullyConnectedLayer(64, 'Name', 'special 2');
```

```
layers(end+1) = reluLayer;
```

```
% the new layer adding non-linearity and improves the network's ability to handle data
```

```
layers(end+1) = fullyConnectedLayer(height(tbl), 'Name', 'fc0_2');
```

```
% Add the softmax layer and the classification layer
```

```
layers(end+1) = softmaxLayer;
```

```
layers(end+1) = classificationLayer()
```

ADD LAYERS

Manipulate Deep Learning Networks Easily

Set options for training

```
opts = trainingOptions('sgdm');
```

Train the network

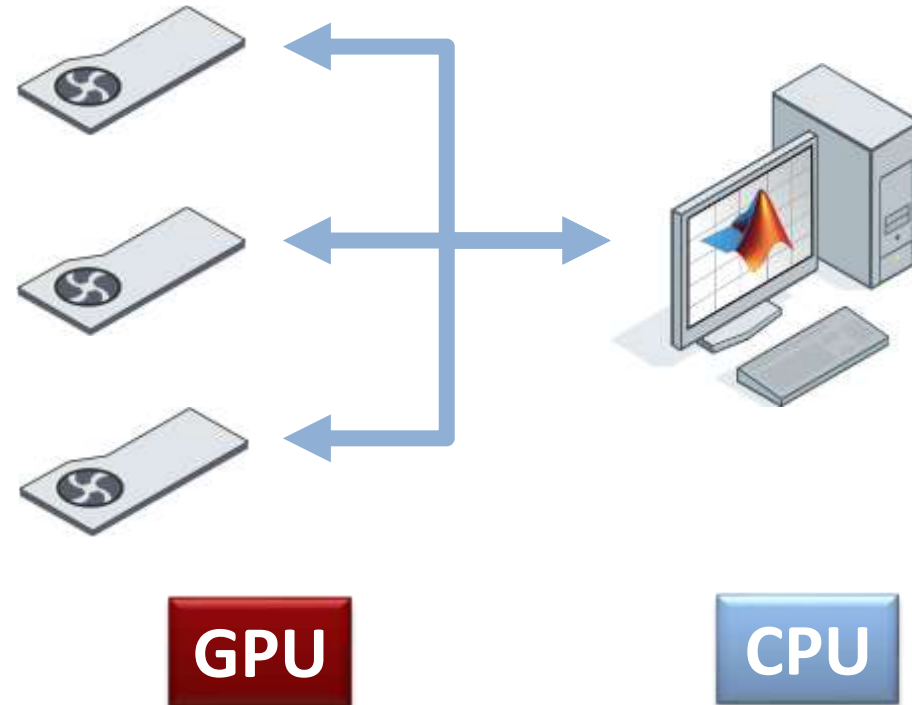
```
net = trainNetwork(imds, layers, opts);
```

Make predictions

```
label = classify(net, im);
```

Extract features

```
features = activations(net, Xtrain, 'fc7');
```



MATLAB makes Deep Learning Easy and Accessible

Learn about new MATLAB capabilities to

- Handle and label large sets of images
- Accelerate deep learning with GPU's
- Visualize and debug deep neural networks
- Access and use models from experts

```
imageDS = imageDatastore(dir)  
Easily manage large sets of images
```

MATLAB makes Deep Learning Easy and Accessible

Learn about new MATLAB capabilities to

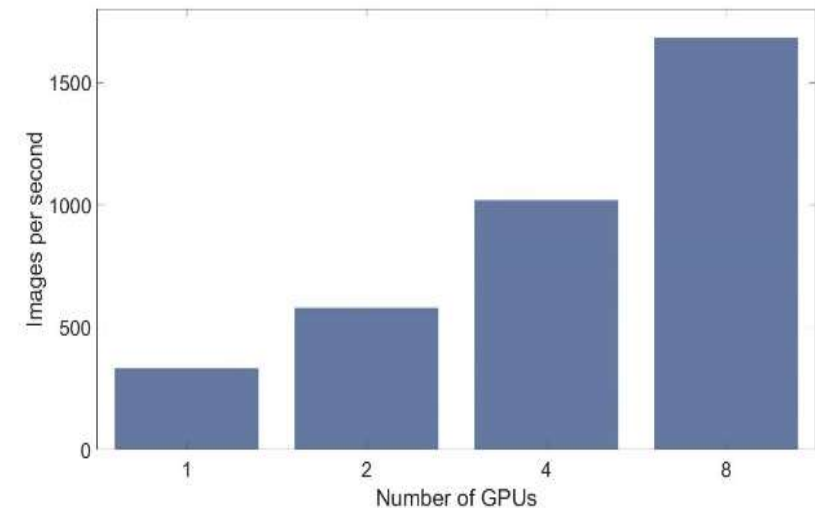
- Handle and label large sets of images
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Training modes supported:

Auto Select
GPU

Multi GPU (local)

Multi GPU (cluster)

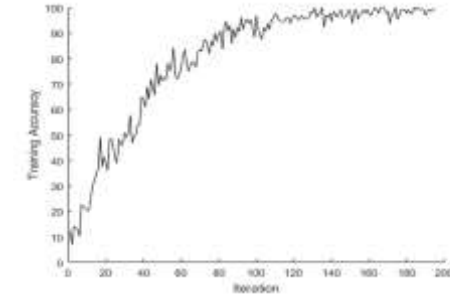


Acceleration with Multiple GPUs

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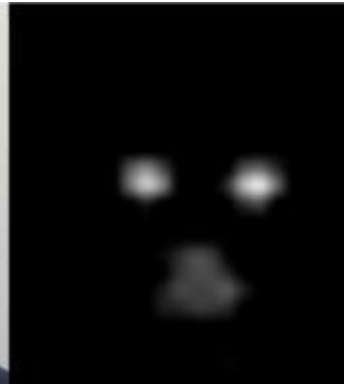
Training Accuracy Plot



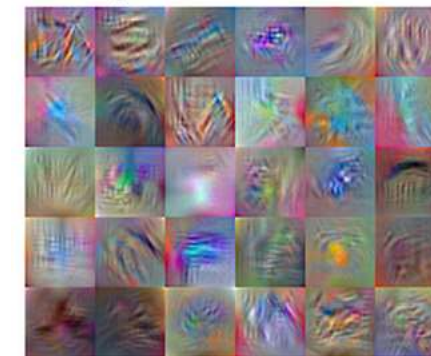
Deep Dream



Network Activations



Layer conv3 Features

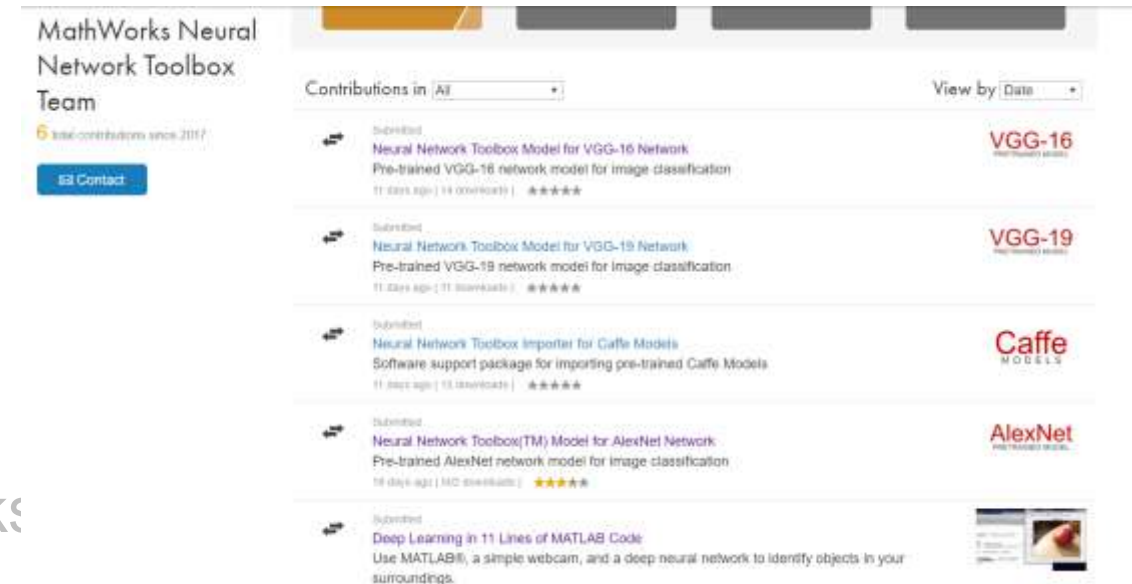


Feature Visualization

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Curated Set of Pretrained Models

Access Models with 1-line of MATLAB Code

```
Net1 = alexnet
Net2 = vgg16
Net3 = vgg19
```

Regression Support for Deep Learning

Classification vs. Regression

- Classification – outputs categories/labels
- Regression – outputs numbers

Supported by new regression layer:

```
rouputlayer = regressionLayer('Name', 'rouput')
```

Example predict facial key-points:



