



University of Colorado
Boulder

Deep Learning Applications for Computer Vision

Lecture 17: Convolutional Neural Network
Tutorial with TensorFlow



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The Data

Last tutorial: CIFAR-10 data

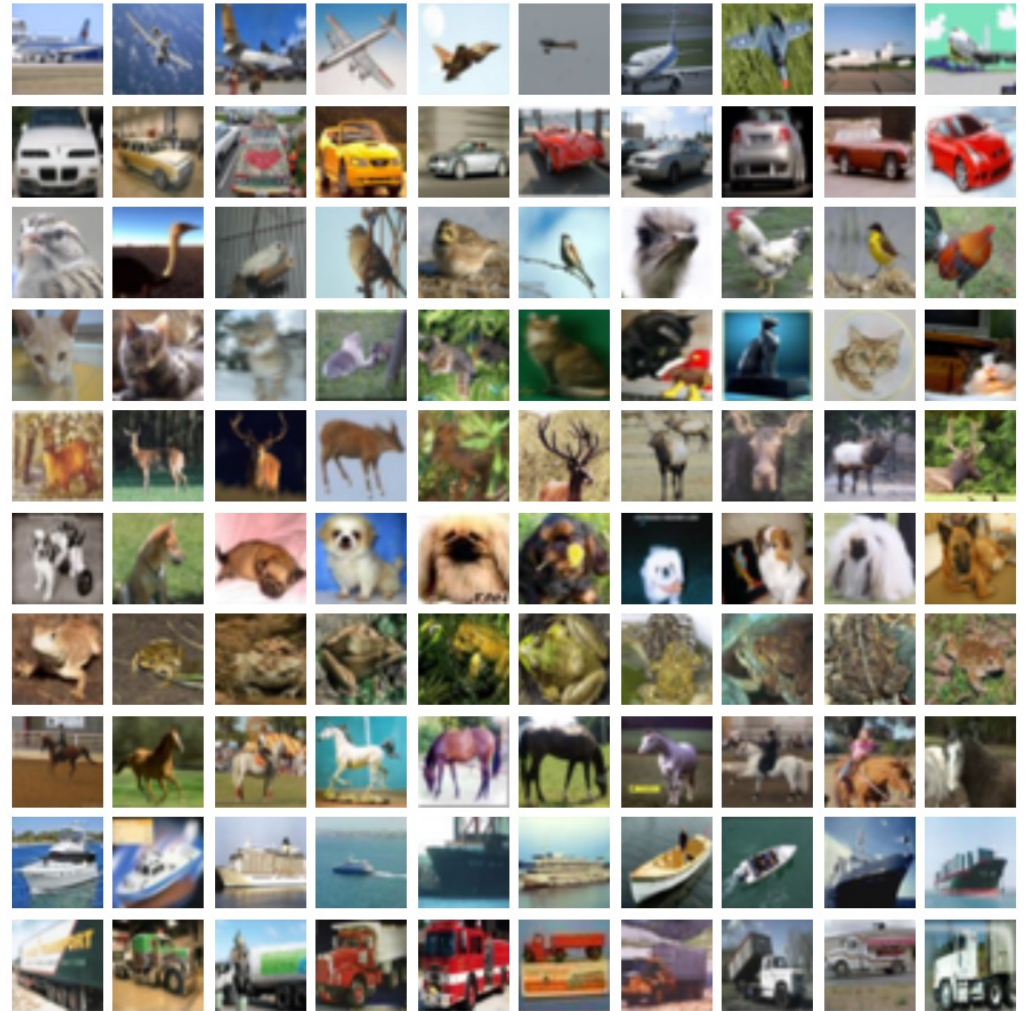
Last model:

- Input layer
- Output layer

Today: CNN

model in *TensorFlow*

- *conv2D* layers
- *maxPooling2D* layers
- *build, train, assess, predict*
- visualize learned filters



TensorFlow tutorial

File name:

- Build_train_CNN_CIFAR10.ipynb
- Build_train_CNN_CIFAR10_v2.ipynb



What have we learned?

1. Import *TensorFlow* and **new** helper libraries
2. Load the data set.
3. Pre-process data. Verify data shape and display
4. Build the network model
 - Sequential
 - Stack layers, one at a time
 - Every conv2D layer is followed by a MaxPooling2D layer
5. Choose Optimizer and loss function
6. Compile and train. Observe loss and accuracy over time
 - Accuracy improves with CNN
 - Accuracy improves with multiple conv2+MaxPooling2D layers
7. Run on *Testing Data*. Observe accuracy.
 - Look at testing accuracy vs training accuracy
8. Predict on new images
9. Visualize learned filters
 - In first convolutional layer
 - In later convolutional layers ???



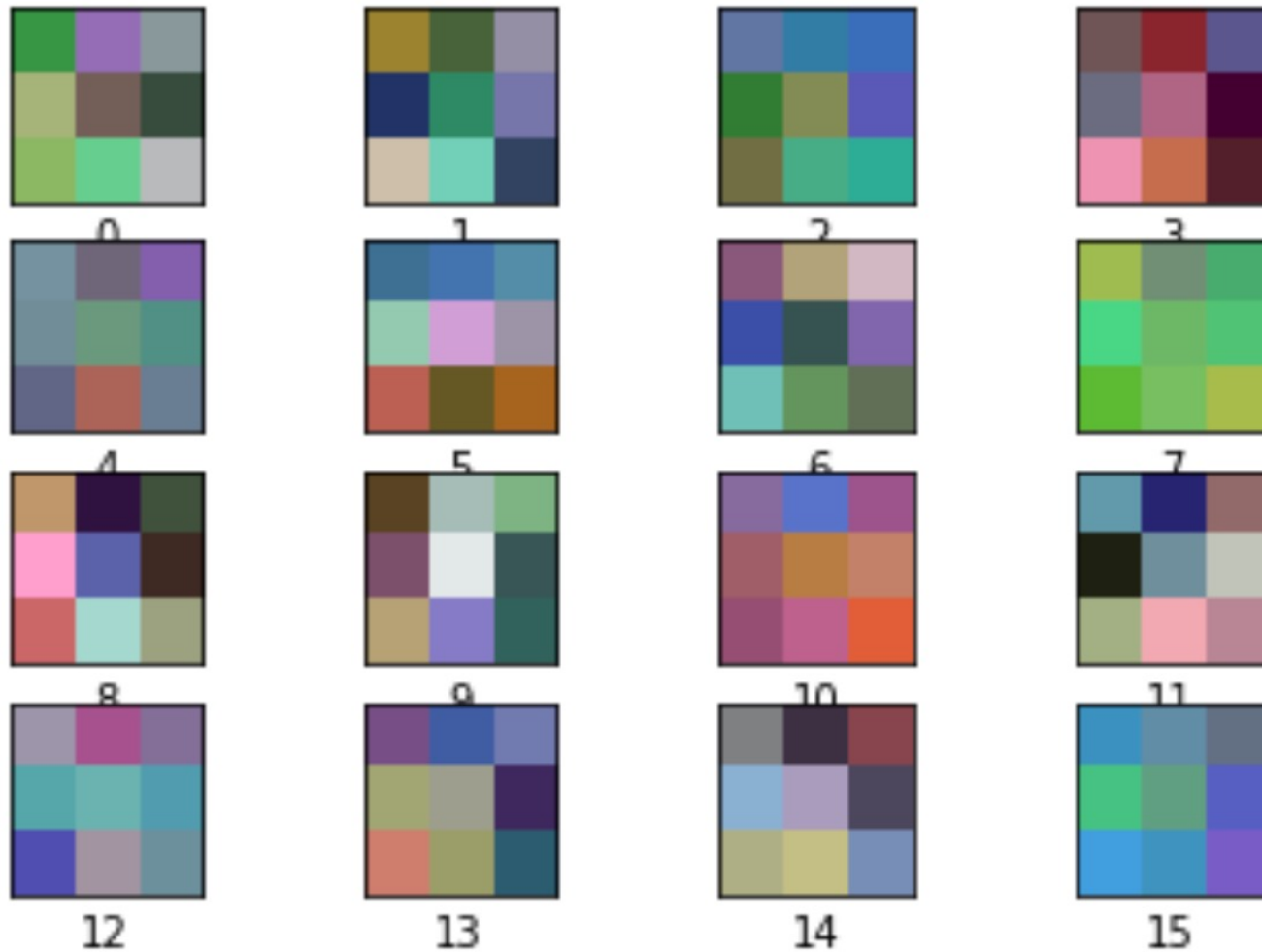
System performance

- Time to train: on the order of ~~seconds~~ minutes
- Overall accuracy:
 - 74.6% on training data
 - 69.7% on testing data
- Number of parameters:
 - from 30K to more than 1 million



Visualizing the filters

- For first convolutional layer



Visualizing the filters

- For second convolutional layer
 - does not have the shape of an image

