

Lecture Notes for **Machine Learning in Python**

Professor Eric Larson
**Demonstration of More Advanced
Convolutional Neural Networks**

Class logistics and Agenda

- CNNs due in the future!
- Agenda:
 - More Advanced CNN Demo
 - CNN Town Hall
 - Next Time: Introduction to RNNs

Class Overview, by topic

Table Data
Visualization

Numpy, Pandas, Seaborn
Overviews with some in-depth discussion

Dimension
Reduction and
Image Processing

Scikit-learn, Scikit Image,
Intuition only, Some mathematics

Linear and
Logistic
Regression

Numpy, Recreate API for Scikit-learn
Detailed mathematics for simple optimization
intuition for advanced optimization

Neural Networks
and Back Prop.

Numpy
Detailed mathematics for NN operations

Wide and Deep
Networks

Convolutional
Networks

Recurrent
Networks

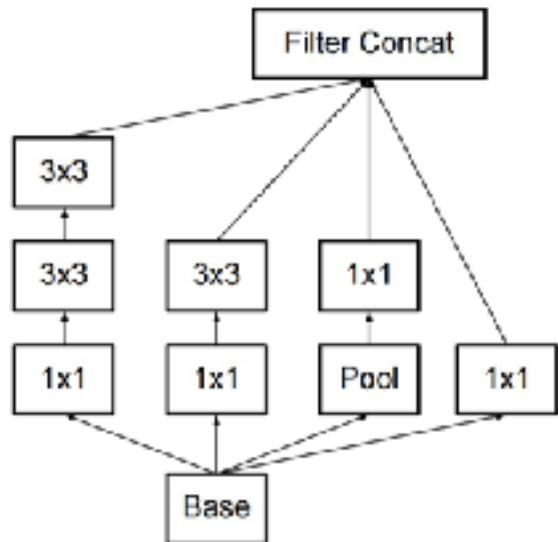
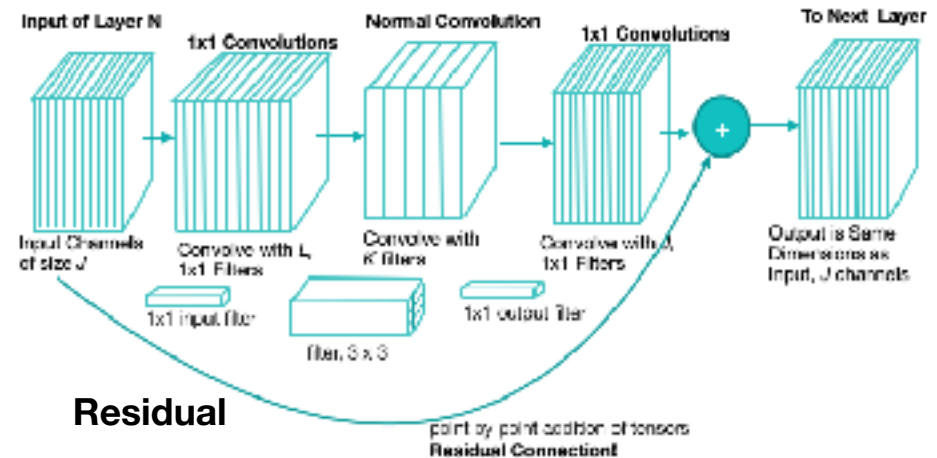
Keras, Tensorflow
Intuition, Detailed implement.

Ethics in
Language Models

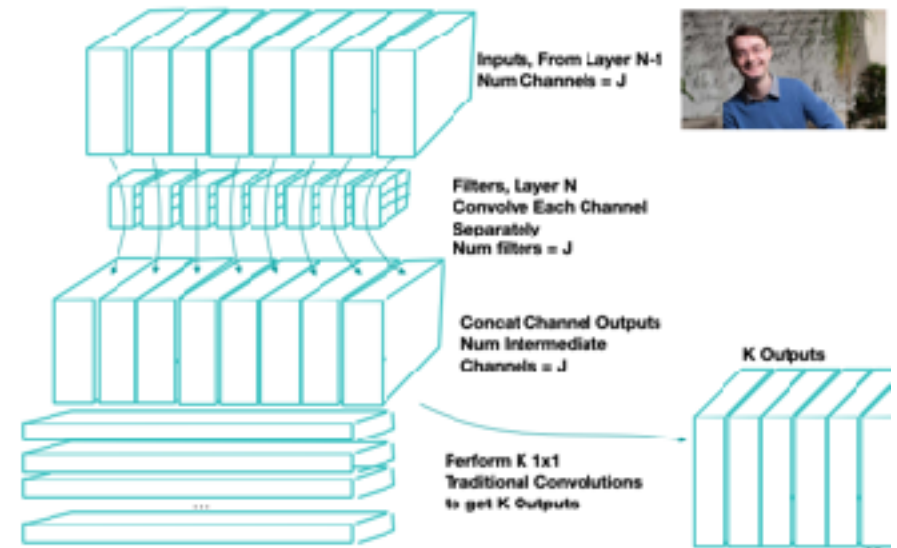
ConceptNet
Case studies

Last Time: More Advanced CNNs

- Bottlenecks (1x1 filters)
- Parallel Paths, Concatenation
- Residual Paths
- Separable Convolution



Parallel Pathways



Separable Convolution

Image Data Augmentation

```
# create data generator  
datagen = ImageDataGenerator()
```

```
# create iterator  
it = datagen.flow_from_directory(X, y, ...)
```

```
# load image dataset  
X, y = ...  
# create iterator  
it = datagen.flow(X, y)
```

```
# define model  
model = ...  
# fit model on the augmented dataset  
model.fit_generator(it, steps_per_epoch=313, ...)
```



**Image
Augmentation**



Demo

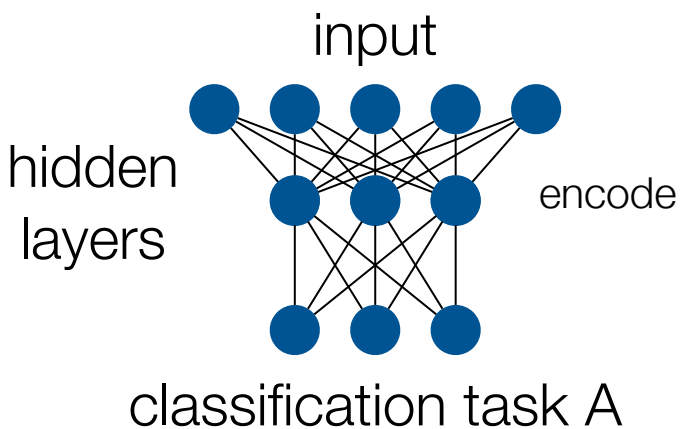
Even more Convolutional
Neural Networks
...in TensorFlow
...with Keras



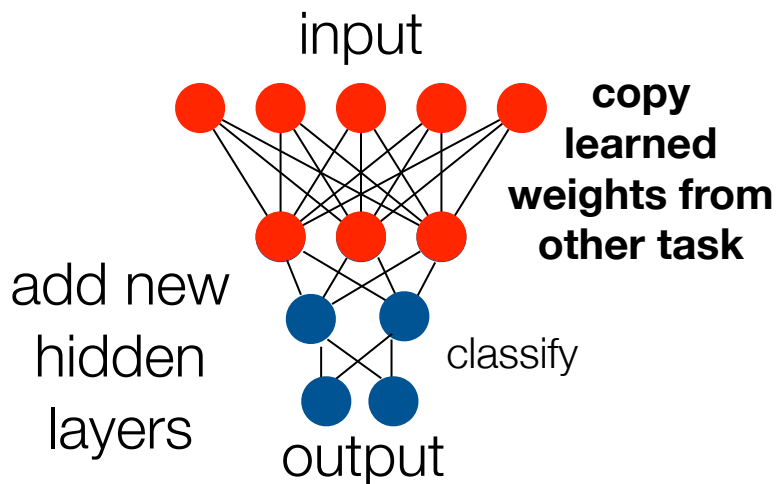
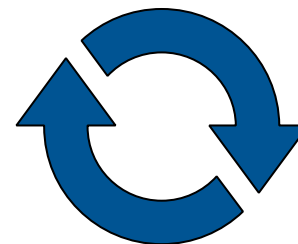
12. More Advanced CNN Techniques.ipynb

Transfer Learning

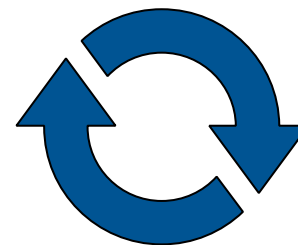
- transfer learning: a basic primer



train with lots of
data (like ImageNet)



train with fewer
labeled data (new task)



Many Pre-trained Models to choose from!

AlexNet

A landmark in computer vision, this 2012 winner of ImageNet has over 50,000 citations.



AlexNet (Places)

The same architecture as the classic AlexNet model, but trained on the Places365 dataset.



Inception v1

Also known as GoogLeNet, this network set the state of the art in ImageNet classification in 2014.



Inception v1 (Places)

The same architecture as the classic Inception v1 model, but trained on the Places365 dataset.



VGG 19

Introduced in 2014, this network is simpler than Inception variants, using only 3x3 convolutions and no branches.



Inception v3

Released in 2015, this iteration of the Inception architecture improved performance and efficiency.



Inception v4

Released in 2016, this is the fourth iteration of the inception architecture, focusing on uniformity.



ResNet v2 50

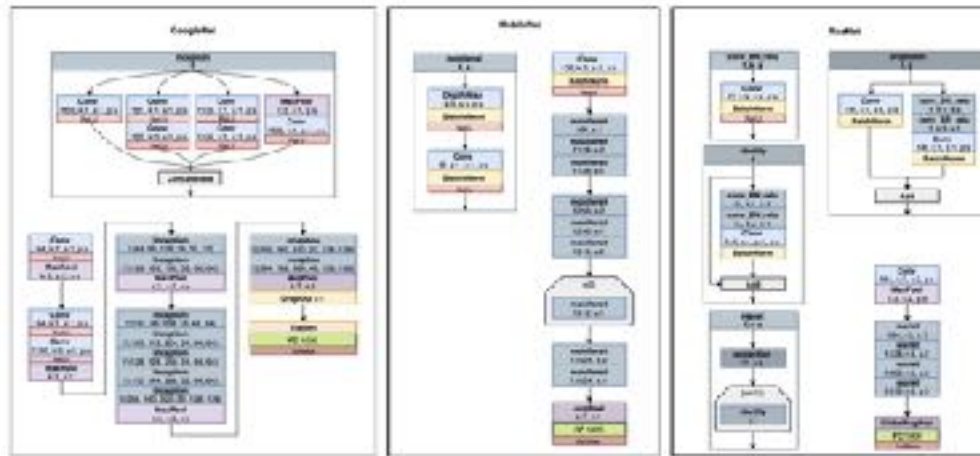
ResNets use skip connections to enable stronger gradients in much deeper networks. This variant has 50 layers.



More Modern CNN Architectures

Even more Convolutional
Neural Networks
...in TensorFlow
...with Keras

Demo



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CNN Town Hall



Machine Learning 101

Next Time:

- Intro to Recurrent Neural Network Architectures
 - RNNs, GRUs, LSTMs
 - Ethics by Case Study