Image Augmentation for Deep Learning With Keras

by **Jason Brownlee** on June 29, 2016 in **Deep Learning**

Data preparation is required when working with neural network and deep learning models. Increasingly data augmentation is also required on more complex object recognition tasks.

In this post you will discover how to use data preparation and data augmentation with your image datasets when developing and evaluating deep learning models in Python with Keras.

After reading this post, you will know:

- About the image augmentation API provide by Keras and how to use it with your models.
- How to perform feature standardization.
- How to perform ZCA whitening of your images.
- How to augment data with random rotations, shifts and flips.
- How to save augmented image data to disk.

Let's get started.

- **Update**: The examples in this post were upda
  function was removed.
- **Update Oct/2016**: Updated examples for Kera
- **Update Jan/2017**: Updated examples for Kera
- **Update Mar/2017**: Updated example for Kera

Keras Image Augmentation A

Like the rest of Keras, the image augmentation AP

Keras provides the ImageDataGenerator class that defines the configuration for image data preparation and augmentation. This includes capabilities such as:

- Sample-wise standardization.
- Feature-wise standardization.
- ZCA whitening.
- Random rotation, shifts, shear and flips.
- Dimension reordering.
- Save augmented images to disk.

An augmented image generator can be created as follows:

```
datagen = ImageDataGenerator()
```

Rather than performing the operations on your entire image dataset in memory, the API is designed to be iterated by the deep learning model fitting process, creating augmented image data for you just-in-time. This reduces your memory overhead, but adds some additional time cost during model training.

After you have created and configured your **ImageDataGenerator**, you must fit it on your data. This will calculate any statistics required to actually perform the transforms to your image data. You can do this by calling the **fit()** function on the data generator and pass it your training dataset.

```
datagen.fit(train)
```

The data generator itself is in fact an iterator, returning batches of image samples when requested. We can configure the batch size and prepare the data generator and get batches of images by calling the **flow()** function.

```
X_batch, y_batch = datagen.flow(train, train, batch_size=32)
```

Finally we can make use of the data generator. Instead of calling the **fit()** function on our model, we must call the **fit_generator()** function and pass in the data generator and the desired length of an epoch as well as the total number of epochs on which to train.

```
fit_generator(datagen, samples_per_epoch=len(train), epochs=100)
```

You can learn more about the Keras image data generator API in the Keras documentation.

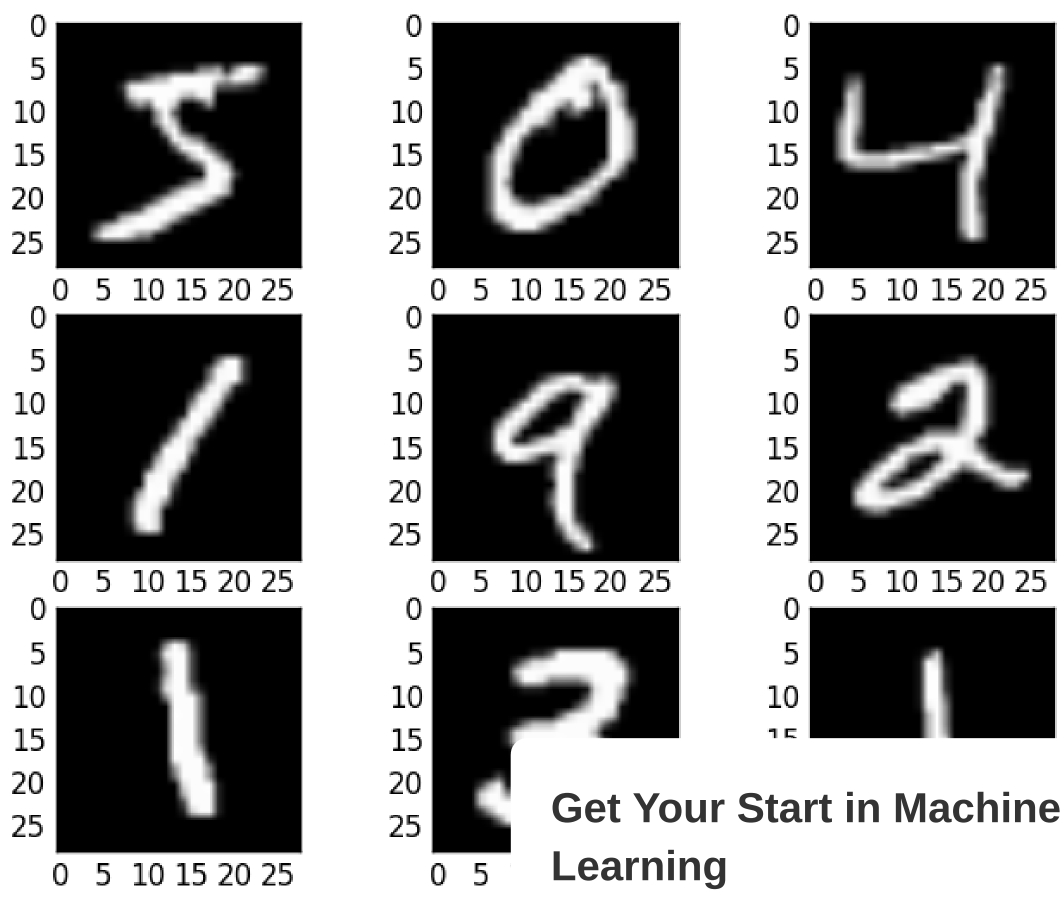
Point of Comparison for Imag

Now that you know how the image augmentation API in Keras works, let's look at some examples.

We will use the MNIST handwritten digit recognition task in these examples. To begin with, let's take a look at the first 9 images in the training dataset.

```python
# Plot images
from keras.datasets import mnist
from matplotlib import pyplot
# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# create a grid of 3x3 images
for i in range(0, 9):
    pyplot.subplot(330 + 1 + i)
    pyplot.imshow(X_train[i], cmap=pyplot.get_cmap('gray'))
# show the plot
pyplot.show()
```

Running this example provides the following image that we can use as a point of comparison with the image preparation and augmentation in the examples below.



Example

Feature Standardization

It is also possible to standardize pixel values acros
standardization and mirrors the type of standardiz
dataset.

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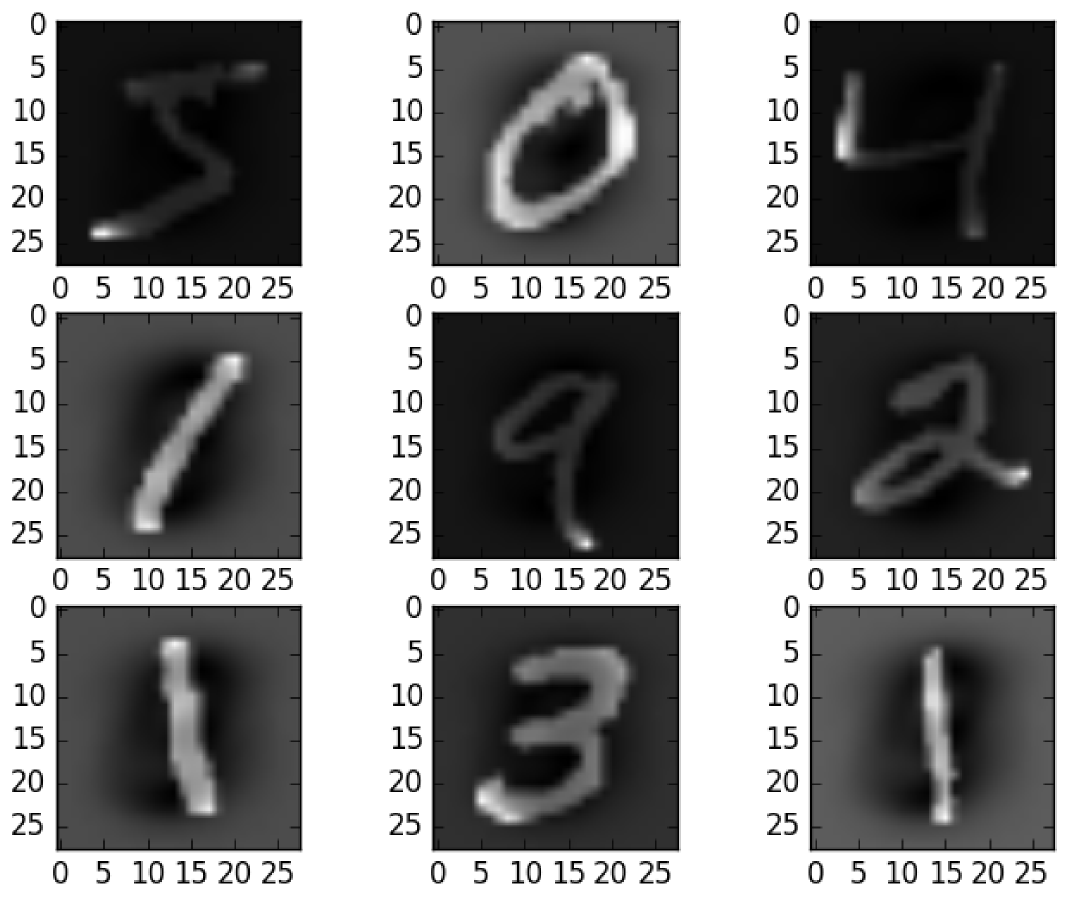
You can perform feature standardization by setting the featurewise_center and featurewise_std_normalization arguments on the ImageDataGenerator class. These are in fact set to True by default and creating an instance of ImageDataGenerator with no arguments will have the same effect.

```python
# Standardize images across the dataset, mean=0, stdev=1
from keras.datasets import mnist
from keras.preprocessing.image import ImageDataGenerator
from matplotlib import pyplot
from keras import backend as K
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# reshape to be [samples][pixels][width][height]
X_train = X_train.reshape(X_train.shape[0], 1, 28, 28)
X_test = X_test.reshape(X_test.shape[0], 1, 28, 28)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator(featurewise_center=True, featurewise_std_normalization=True)
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of images
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9):
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running this example you can see that the effect is different, seemingly darkening and lightening different digits.



Standardized Feature MNIST Images

ZCA Whitening

A whitening transform of an image is a linear algebra operation that reduces the redundancy in the matrix of pixel images.

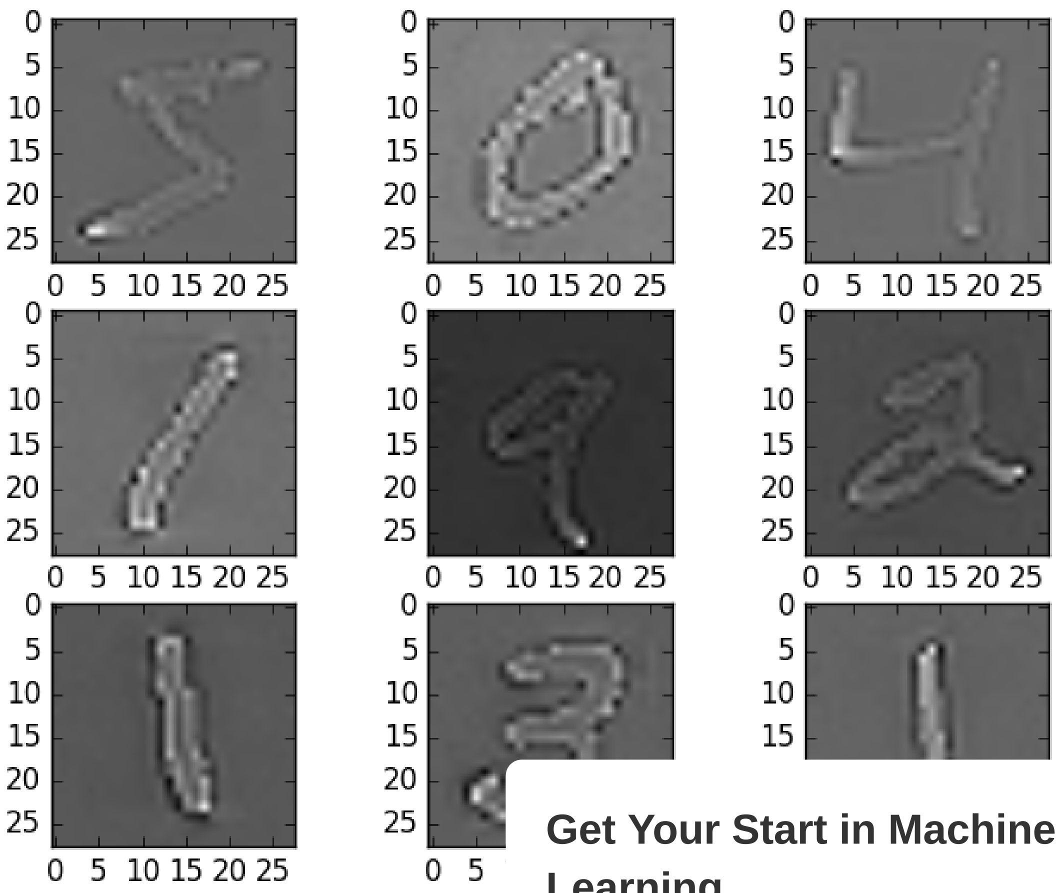
Less redundancy in the image is intended to better highlight the structures and features in the image to the learning algorithm.

Typically, image whitening is performed using the Principal Component Analysis (PCA) technique. More recently, an alternative called ZCA (learn more in A s and results in transformed images that keeps all of l transformed images still look like their originals.

You can perform a ZCA whitening transform by set

```
# ZCA whitening
from keras.datasets import mnist
from keras.preprocessing.image import Imag
from matplotlib import pyplot
from keras import backend as K
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mni
# reshape to be [samples][pixels][width][h
X_train = X_train.reshape(X_train.shape[0]
X_test = X_test.reshape(X_test.shape[0], 1, 28, 28)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator(zca_whitening=True)
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of images
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9):
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running the example, you can see the same general structure in the images and how the outline of each digit has been highlighted.



ZCA Whiteni

Random Rotations

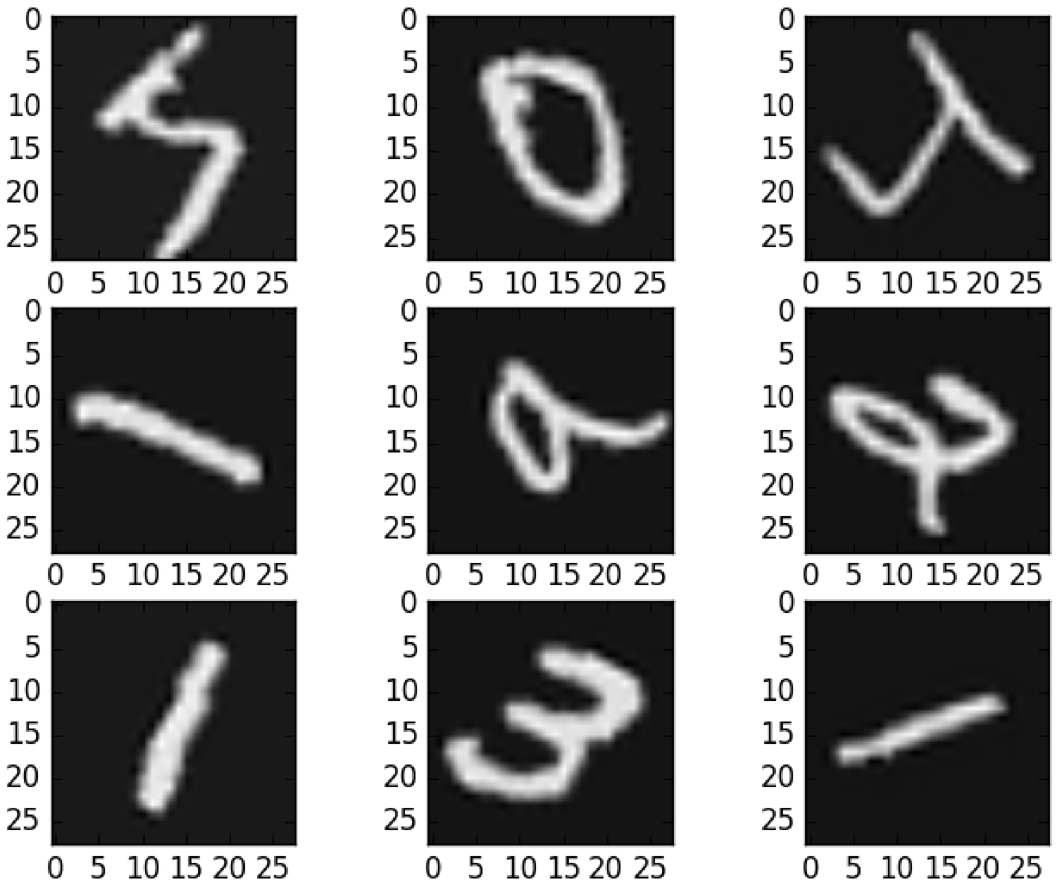
Sometimes images in your sample data may have

You can train your model to better handle rotations images from your dataset during training.

The example below creates random rotations of the MNIST digits up to 90 degrees by setting the rotation_range argument.

```python
# Random Rotations
from keras.datasets import mnist
from keras.preprocessing.image import ImageDataGenerator
from matplotlib import pyplot
from keras import backend as K
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# reshape to be [samples][pixels][width][height]
X_train = X_train.reshape(X_train.shape[0], 1, 28, 28)
X_test = X_test.reshape(X_test.shape[0], 1, 28, 28)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator(rotation_range=90)
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of images
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9):
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running the example, you can see that images have been rotated left and right up to a limit of 90 degrees. This is not helpful on this problem because the MNIST digits have a normalized orientation, but this transform might be of help when learning from photographs where the objects may have different orientations.



Random Rotations of MNIST Images

Random Shifts

Objects in your images may not be centered in the frame. They may be off-center in a variety of different ways.

You can train your deep learning network to expect and currently handle off-center objects by artificially creating shifted versions of your training data. Keras supports separate horizontal and vertical random shifting of training data by the width_shift_range and height_shift_range arguments.

```
# Random Shifts
from keras.datasets import mnist
from keras.preprocessing.image import Imag
from matplotlib import pyplot
from keras import backend as K
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mni
# reshape to be [samples][pixels][width][h
X_train = X_train.reshape(X_train.shape[0]
X_test = X_test.reshape(X_test.shape[0], 1
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
shift = 0.2
datagen = ImageDataGenerator(width_shift_r
# fit parameters from data
datagen.fit(X_train)
```

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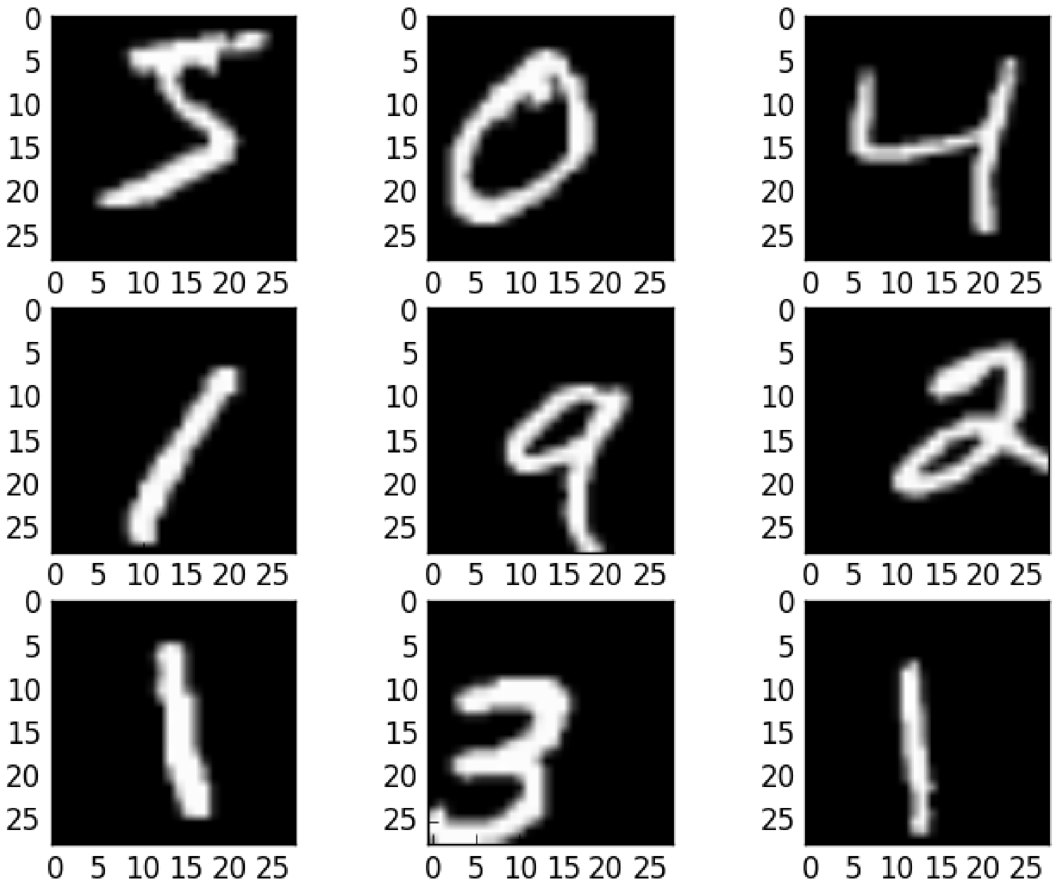
```
# configure batch size and retrieve one batch of images
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9):
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running this example creates shifted versions of the digits. Again, this is not required for MNIST as the handwritten digits are already centered, but you can see how this might be useful on more complex problem domains.



Random Shift

Random Flips

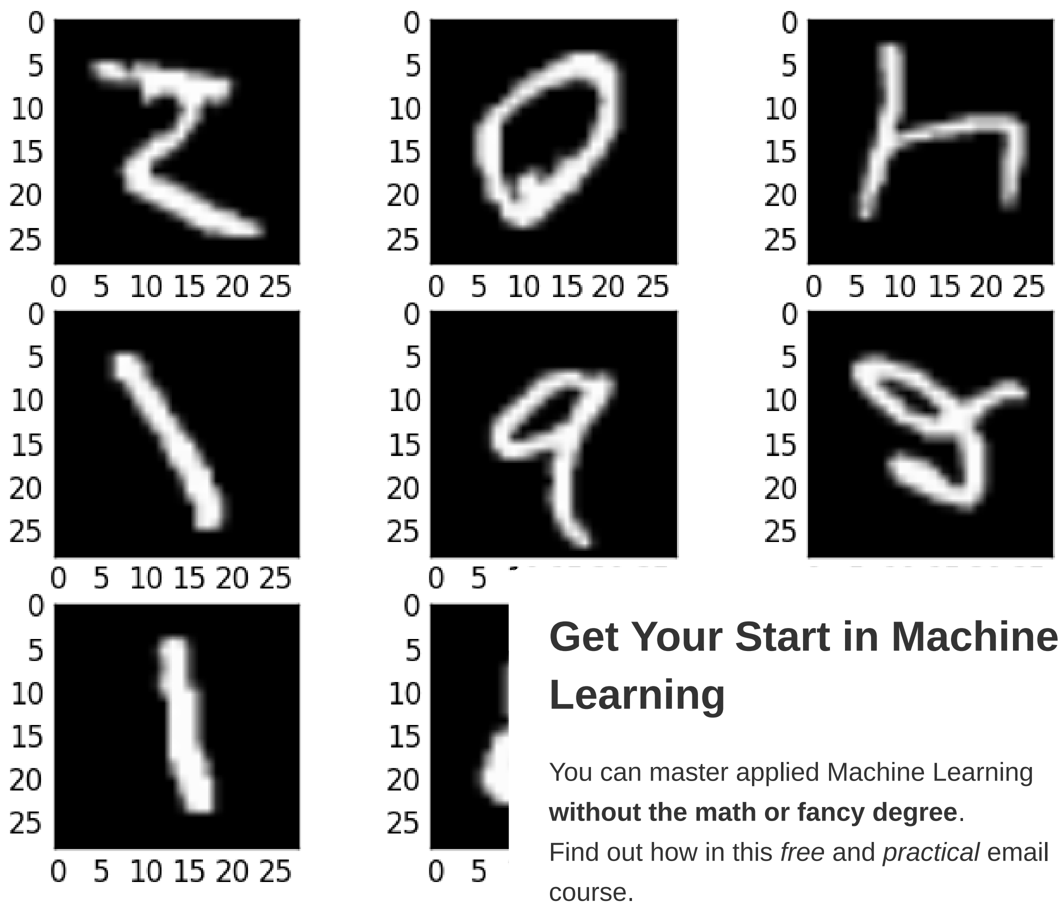
Another augmentation to your image data that can problems is to create random flips of images in you

Keras supports random flipping along both the ver horizontal_flip arguments.

```
# Random Flips
from keras.datasets import mnist
from keras.preprocessing.image import Imag
from matplotlib import pyplot
from keras import backend as K
```

```
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# reshape to be [samples][pixels][width][height]
X_train = X_train.reshape(X_train.shape[0], 1, 28, 28)
X_test = X_test.reshape(X_test.shape[0], 1, 28, 28)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator(horizontal_flip=True, vertical_flip=True)
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of images
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9):
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running this example you can see flipped digits. Flipping digits is not useful as they will always have the correct left and right orientation, but this may be useful for problems with photographs of objects in a scene that can have a varied orientation.



Randomly Flip

Saving Augmented Images to

The data preparation and augmentation is performed just in time by Keras.

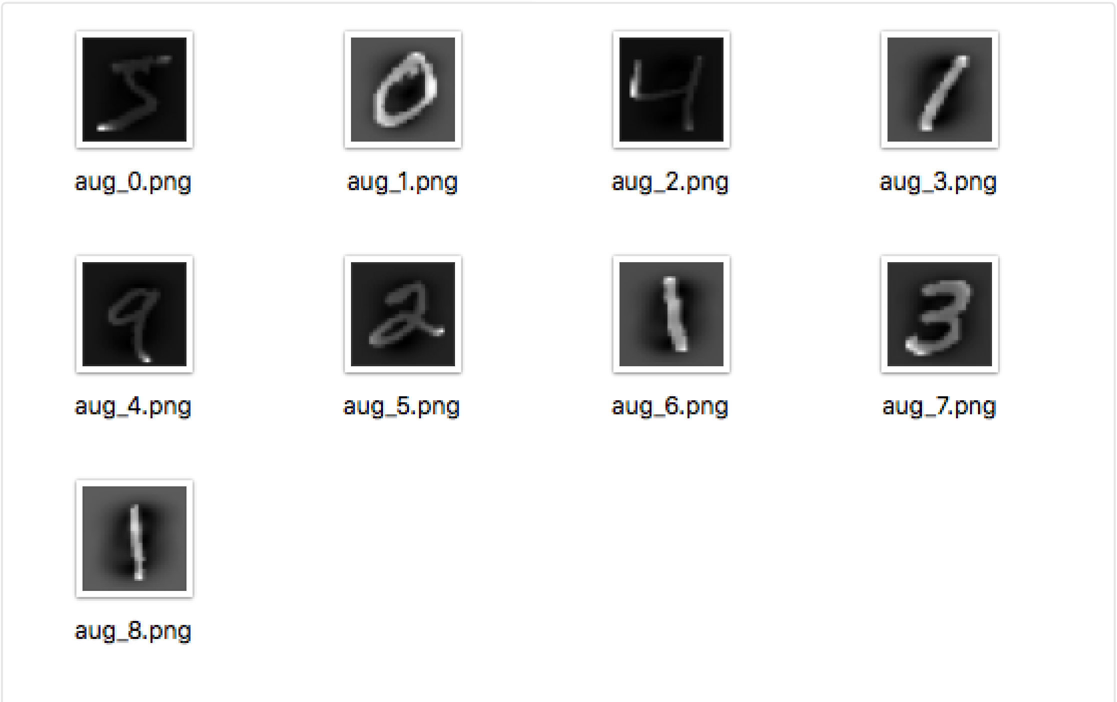
This is efficient in terms of memory, but you may require the exact images used during training. For example, perhaps you would like to use them with a different software package later or only generate them once and use them on multiple different deep learning models or configurations.

Keras allows you to save the images generated during training. The directory, filename prefix and image file type can be specified to the flow() function before training. Then, during training, the generated images will be written to file.

The example below demonstrates this and writes 9 images to a “images” subdirectory with the prefix “aug” and the file type of PNG.

```python
# Save augmented images to file
from keras.datasets import mnist
from keras.preprocessing.image import ImageDataGenerator
from matplotlib import pyplot
import os
from keras import backend as K
K.set_image_dim_ordering('th')
# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# reshape to be [samples][pixels][width][height]
X_train = X_train.reshape(X_train.shape[0], 1, 28, 28)
X_test = X_test.reshape(X_test.shape[0], 1, 28, 28)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator()
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of images
os.makedirs('images')
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9, save_to_dir='images', 
    # create a grid of 3x3 images
    for i in range(0, 9):
        pyplot.subplot(330 + 1 + i)
        pyplot.imshow(X_batch[i].reshape(28, 28), cmap=pyplot.get_cmap('gray'))
    # show the plot
    pyplot.show()
    break
```

Running the example you can see that images are only written when they are generated.



Augmented MNIST Images Saved To File

Tips For Augmenting Image Data with Keras

Image data is unique in that you can review the data and transformed copies of the data and quickly get an idea of how the model may be perceive it by your model.

Below are some times for getting the most from image data preparation and augmentation for deep learning.

- **Review Dataset**. Take some time to review your dataset in great detail. Look at the images. Take note of image preparation and augmentations that might benefit the training process of your model, such as the need to handle different shifts, rotations or flips of objects in the scene.
- **Review Augmentations**. Review sample images after the augmentation has been performed. It is one thing to intellectually know what image transforms you are using, it is a very different thing to look at examples. Review images both with individual augmentations you are using as well as the full set of augmentations you plan to use. You may see ways to simplify or further enhance your model training process.
- **Evaluate a Suite of Transforms**. Try more than one image data preparation and augmentation scheme. Often you can be surprised by result would be beneficial.

Summary

In this post you discovered image data preparatior

You discovered a range of techniques that you car models. You learned about:

- The ImageDataGenerator API in Keras for gei
- Sample-wise and Feature wise pixel standard
- The ZCA whitening transform.

- Random rotations, shifts and flips of images.
- How to save transformed images to file for later reuse.

Do you have any questions about image data augmentation or this post? Ask your questions in the comments and I will do my best to answer.

About Jason Brownlee

Dr. Jason Brownlee is a husband, proud father, academic researcher, author, professional developer and a machine learning practitioner. He is dedicated to helping developers get started and get good at applied machine learning. Learn more.

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60 Responses to *Image Augmentatio*

Andy August 2, 2016 at 7:34 am # REPLY

Interesting tutorial.

I'm working through the step to standardize images across the dataset and run into the following error:

AttributeError Traceback (most recent call last)
in ()
18 datagen.flow(X_train, y_train, batch_size=9)
19 # retrieve one batch of images
—> 20 X_batch, y_batch = datagen.next()
21 # create a grid of 3×3 images
22 for i in range(0, 9):

AttributeError: 'ImageDataGenerator' object has no attribute 'next'

I have checked the Keras documentation and see no mention of a next attribute.

Perhaps I'm missing something.

Thanks for the great tutorials!

Jason Brownlee August 2, 2016 at 8:21 am # REPLY

Yep, the API has changed. See:
https://keras.io/preprocessing/image/

I will update all of the examples ASAP.

UPDATE: I have updated all examples in this post to use the new API. Let me know if you have any problems at all.

Andy August 3, 2016 at 9:18 am # REPLY

Works like a charm! Thanks

Jason Brownlee August 3, 20

Glad to hear it Andy.

narayan August 9, 2016 at 6:38 pm #

for X_batch, y_batch in datagen.flow(X_tr
File "/usr/local/lib/python2.7/dist-packages/keras/pr
x = self.image_data_generator.random_transform(
File "/usr/local/lib/python2.7/dist-packages/keras/pr

random_transform
fill_mode=self.fill_mode, cval=self.cval)
File "/usr/local/lib/python2.7/dist-packages/keras/preprocessing/image.py", line 109, in apply_transform
x = np.stack(channel_images, axis=0)
AttributeError: 'module' object has no attribute 'stack'

how to solve this error …?

Jason Brownlee August 15, 2016 at 11:13 am # REPLY

I have not seen an error like that before. Perhaps there is a problem with your environment?

Consider re-installing Theano and/or Keras.

narayan August 26, 2016 at 9:02 pm # REPLY

i solved this error by updating numpy version ….previously it 1.8.0..now 1.11.1..it means it should be more than 1.9.0

Jason Brownlee August 27, 2016 at 11:33 am # REPLY

Great, glad to here it narayan.

narayan August 26, 2016 at 9:05 pm # REPLY

Now i have question that how to decide value for this parameter So that i can get good testing accuracy ..i have training dataset with 110 category with 32000 images ..

featurewise_center=False,
samplewise_center=False,
featurewise_std_normalization=False,
samplewise_std_normalization=False,
zca_whitening=False,
rotation_range=0.,
width_shift_range=0.,
height_shift_range=0.,
shear_range=0.,
zoom_range=0.,
channel_shift_range=0.,
fill_mode='nearest',
cval=0.,
horizontal_flip=False,
vertical_flip=False,

rescale=None,
dim_ordering=K.image_dim_ordering()

Waiting for your positive reply…

Jason Brownlee August 27, 2016 at 11:34 am # REPLY

My advice is to try a suite of different configurations and see what works best on your problem.

Walid Ahmed November 9, 2016 at 2:08 am # REPLY

Thanks a lot.
all worked fine except the last code to save images to file, I got the following exception

```
Walids-MacBook-Pro:DataAugmentation walidahmed$ python augment_save_to_file.py
Using TensorFlow backend.
Traceback (most recent call last):
File "augment_save_to_file.py", line 20, in
for X_batch, y_batch in datagen.flow(X_train, y_train, batch_size=9, save_to_dir='images', save_prefix='aug', save_format='png'):
File "/usr/local/lib/python2.7/site-packages/keras/preprocessing/image.py", line 490, in next
img = array_to_img(batch_x[i], self.dim_ordering, scale=True)
File "/usr/local/lib/python2.7/site-packages/keras/preprocessing/image.py", line 140, in array_to_img
raise Exception('Unsupported channel number: ', x.shape[2])
Exception: ('Unsupported channel number: ', 28)
```

Any advice?
thanks again

Jason Brownlee November 9, 2016 at 9:52 am # REPLY

Double check your version of Keras is 1.1.0 and TensorFlow is 0.10

Sudesh November 11, 2016 at 9:37 pm #

Hello Jason,

Thanks a lot for your tutorial. It is helping me in ma

I had question on mask image or target Y for trainir
Can i also transform Y along with X. Helps in the ca

Sudesh November 15, 2016 at 5:25 am # REPLY

I managed to do it.

datagen = ImageDataGenerator(shear_range=0.02,dim_ordering=K._image_dim_ordering,rotation_range=5,width_shift_range=0.05, height_shift_range=0.05,zoom_range=0.3,fill_mode='constant', cval=0)

for samples in range(0,100):
seed = rd.randint(low=10,high=100000)
for imags_batch in datagen.flow(imgs_train,batch_size=batch_size,save_to_dir='augmented',save_prefix='aug',seed=seed,save_format='tif'):
print('-')
break
for imgs_mask_batch in datagen.flow(imgs_mask_train, batch_size=batch_size, save_to_dir='augmented',seed=seed, save_prefix='mask_aug',save_format='tif'):
print('|')
break
print((samples+1)*batch_size)

Addie November 29, 2016 at 6:01 am # REPLY

This is great stuff but I wonder if you could provide an example like this with an RGB image with three channels? I am getting some really buggy results personally with this ImageGenerator.

Jason Brownlee November 29, 2016 at 8:55 am # REPLY

Great suggestion, thanks Addie.

Lucas December 24, 2016 at 9:02 am # REPLY

I wonder what `channel_shift_range` i
but what does this actually mean? Is it adding a ra

Jason Brownlee December 26, 2016 at

I have not used this one yet, sorry Lu

You could try experimenting with it or dive into

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Indra December 26, 2016 at 5:30 pm # REPLY

Hi,

Thanks for the post. I've one question i.e., we do feature standardization in the training set, so while testing, we need those standardized values to apply on testing images ?

Jason Brownlee December 27, 2016 at 5:22 am # REPLY

Yes Indra, any transforms like standardization performed on the data prior to modeling will also need to be performed on new data when testing or making predictions.

In the case of standardization, we need to keep track of means and standard deviations.

Dan March 11, 2017 at 11:01 pm # REPLY

Thanks again Jason. Why do we subplot 330+1+i? Thanks

Jason Brownlee March 12, 2017 at 8:24 am # REPLY

This is matplotlab syntax.

The 33 creates a grid of 3×3 images. The number after that (1-9) indicates the position in that grid to place the next image (left to right, top to bottom ordering).

I hope that helps.

Vineeth March 13, 2017 at 7:52 pm # REPLY

How do I save the augmented images into a directory with a class label prefix or even better into a subdirectory of class name?

Jason Brownlee March 14, 2017 at 8:15

Great question Vineeth,

You can specify any directory and filename pre

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Richa March 21, 2017 at 10:45 pm #

can we augment data of a particular class. I mean images of a class which are less, to deal with the class imbalance problem.

Jason Brownlee March 22, 2017 at 8:06 am # REPLY

Great idea.

Yes, but you may need to prepare the data for each class separately.

Lebron March 26, 2017 at 4:07 pm # REPLY

Hi Jason,

Thanks for your post!

I have a question: Does this apply to image data with RGBXYZ for each pixel?

Each of my input image is of six channels including RGB and XYZ (world coordinate), which was acquired from an organized point cloud by PCL(Point Cloud Library). I am wondering whether there is a correct way to do data augmentation for my images.

I think ImageDataGenerator might be correct only for RGB images? Because when you shift/rotate/flip the RGB image, it means camera movement indeed, and the XYZ coordinates should be changed as well.

Thanks.

Jason Brownlee March 27, 2017 at 7:52 am # REPLY

Hi Lebron, I believe this specific API is intended for 3d pixel data. You might be able to devise your own similar domain-specific transforms for you own data.

Lebron March 27, 2017 at 3:51 pm #

Thanks Jason!

To confirm, do you mean image with RGB I

have to do all the augmentation by myself,

Jason Brownlee March 28, 20

Yes, I believe that to be the ca

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Brian April 16, 2017 at 9:35 am # REPLY

When I use zoom_range of 0.2 and inspect the output images, it seems to zoom h and v axes independently. However I want to have a small amount of zoom variation while preserving the aspect ratio of the images.

Also, when I specify a rotation_range, the rotated images have aliasing artefacts. Is there any way to specify rotations with antialiasing?

Jason Brownlee April 17, 2017 at 5:06 am # REPLY

I'm not sure off hand.

Do you think these concerns will affect the skill of the model?

Brian April 19, 2017 at 11:15 am # REPLY

Thanks Jason,

Aspect ratio of the image is important in a facial recognition setting. Antialiasing of rotated images I'm not so sure about, but as they are small images (244 x 244) it doesn't make sense to degrade them further.

I can modify my own copy of the Keras code to maintain the aspect ratio of the zoom and should be able to substitute PIL's rotation function, which does antialiasing, for the one used in Keras.

Keep up the good work, your writing has really helped me get up to speed with Keras quickly

Jason Brownlee April 20, 2017 at 9:21 am # REPLY

Very nice Brian.

Let me know how you go.

Joe April 23, 2017 at 4:27 pm #

Hi Brian.

The transformations in ImageGeneratc
[scipy.ndimage.interpolation.affine_trar
0.14.0/reference/generated/scipy.ndim
(the order of spline used for interpolati

Change this to one for linear interpolat

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Wuchi May 4, 2017 at 5:38 pm # REPLY

Hi Jason,

Thank you for your post! Very clear!
I am trying to use ImageDataGenerator now. But if I want to apply feature standardization to unseen data in the future, I need to save the ImageDataGenerator to disk, right? Any suggestion to do it? Thanks a lot.

Jason Brownlee May 5, 2017 at 7:29 am # REPLY

That is correct, or you can standardize manually and just save the coefficients used.

RogerLo May 17, 2017 at 2:23 pm # REPLY

Hi Jason

I using Keras 2.x 'tf' seeting.
Why I can't using
X_batch, y_batch = datagen.flow(train, train, batch_size=32)
For example :

from keras.datasets import mnist
from keras.preprocessing.image import ImageDataGenerator

# load data
(X_train, y_train), (X_test, y_test) = mnist.load_data()
# reshape to be [samples][pixels][width][height]
X_train = X_train.reshape(X_train.shape[0], 28, 28,1)
X_test = X_test.reshape(X_test.shape[0], 28, 28,1)
# convert from int to float
X_train = X_train.astype('float32')
X_test = X_test.astype('float32')
# define data preparation
datagen = ImageDataGenerator(featurewise_center=True, featurewise_std_normalization=True)
# fit parameters from data
datagen.fit(X_train)
# configure batch size and retrieve one batch of im
X_batch, y_batch = datagen.flow(X_train, y_train, b

Can you tell me why?
Thanks!

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Jason Brownlee May 18, 2017 at 8:28 a

What error do you get exactly?

RogerLo May 19, 2017 at 4:26 pm # REPLY

Hi, Hason

The error message is :
too many values to unpack (expected 2)

Jason Brownlee May 20, 2017 at 5:35 am # REPLY

I'm sorry I have not seen this error before, I do not have any good suggestions.

Fahad June 16, 2017 at 12:25 am # REPLY

Hi Jason,

I have training data of the shape (2000,4,100,100) which means 2000 samples of the size 100×100 with 4 channels and dtype= uint8, stored as '.npy' file. Can I use Image Augmentation technique on such data?

Jason Brownlee June 16, 2017 at 8:03 am # REPLY

You may, try it and see.

Umberto June 23, 2017 at 7:00 pm # REPLY

Hi Jason,
Since I used the fit_generator method instead of fit(), I need to use evaluate_generator in order to correctly evaluate the model or not? Is the same for predict_generator? I'm a little confused.

Matthew Hancock June 25, 2017 at 1:03 am

Hi Jason,

I have a quick question about the image augmenta
my training data set using data augmentation in or
image generator feed multiple augmentations of th
single augmented version instead of the original? T
augmented images the Image Data Generator actu

Matthew Hancock June 25, 2017 at 1:06 am # REPLY

Never mind, I found my answer in the Keras documentation.

Jason Brownlee June 25, 2017 at 6:03 am # REPLY

Glad to hear it.

Jason Brownlee June 25, 2017 at 6:02 am # REPLY

Great question.

From the doc: "The data will be looped over (in batches) indefinitely."
https://keras.io/preprocessing/image/

Alice July 4, 2017 at 7:30 pm # REPLY

Hello Jason,
I made the exercice with your book which I find just great!!!
The problem is: it applies on randomly choosen images instead of doing it on the same ones from the "Point of comparison" sub-chapter. And always different samples.
How could I solve this?
I must say I don't understand how it comes the "i" applies on the pyplot.subplot and on the X-batch[].
Thank you!!
Alice

Jason Brownlee July 6, 2017 at 10:14 am # REPLY

Think of the augmented images as randomly modified versions of your training dataset. You have a new dataset with lots of variations of th
to the original examples.

Or perhaps I misunderstand your question?

Nathan July 25, 2017 at 6:39 pm #

I think the problem of Alice is the
modification are never the same, which is
everytime.

For example :
-the first plot gives me : 5 6 3, 0 1 9, 2 3 1

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– after the ZCA whitening i have : 2 3 8, 3 2 5, 0 1 7

Jason Brownlee July 26, 2017 at 7:48 am # REPLY

Yes, by design, the augmentation will create different augmented versions of the images each time it is called.

This is what we want, so the model does a better job of generalizing.

What is the problem exactly, could you help me to understand please?

Antoine Simon July 25, 2017 at 10:59 pm # REPLY

Hello Jason,

I have the same problem as Alice. I think that what she was saying was that the pictures that she plot after random modifications are never the same

It looks like the 9 pictures that are plotted are chosen randomly everytime.

It would be nice if you could answer me on this problem,

Thank you !

Jason Brownlee July 26, 2017 at 7:54 am # REPLY

Yes, this is by design. This is exactly what we want from image augmentation.

john Landler July 25, 2017 at 5:45 am # REPLY

Hi,

When I run the above script, I get this error:
Using TensorFlow backend.
C:\Users\sacheu\AppData\Local\Programs\Python\
packages\keras\preprocessing\image.py:653: User
array) following the data format convention "chann
or 4 channels on axis 1. However, it was passed ar
' (' + str(x.shape[self.channel_axis]) + ' channels).')

can you please tell me how to fix it?
i think i have the latest version of the libraries. And

Thank you.

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Jason Brownlee July 25, 2017 at 9:49 am # REPLY

You could try changing the order of the channels in code or in the Keras configuration file.

For example, in code:

```
from keras import backend as K
K.set_image_dim_ordering('th')
```

Or if this is the cause, comment it out.

Xiaojie Zhang July 28, 2017 at 2:45 pm # REPLY

Hi, thanks for your share. When I try to use zca-whitening and feature-wised centering on bigger data, I found it's very very hard to get enough memory to do the fit() function. As the data-set has about 10000 pictures and 224*224 pixels, even generate a flow iterator will use full of my 16GB memory. When try to use fit() for zca-whitening,centering,normalization which the documents said have to use the fit() function, I never success. Will you give some advice for data preparation for bigger data? Thank you very much!

Jason Brownlee July 29, 2017 at 8:04 am # REPLY

Are you able to use the flow_from_directory instead of loading it all into memory?
https://keras.io/preprocessing/image/

Muneer Ahmad Dedmari August 20, 2017 at 10:02 pm # REPLY

Hi Jason,
Thanks for this nice post. I have a quick question. I have large-dataset which I am loading to model using custom data-generator. I am using it in model.fit_generator(). Now I want to use data-augmentation. So my question is, how/where can I use keras ImageDataGenerator? Thank you very much.

Jason Brownlee August 21, 2017 at 6:0

I believe this tutorial will help:
https://blog.keras.io/building-powerful-image-cl

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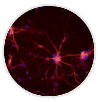
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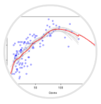

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