Data augmentation and data generators

A nice party trick

Filippo Biscarini
Senior Scientist
CNR, Milan (Italy)

Nelson Nazzicari
Research fellow
CREA, Lodi (Italy)

What is data augmentation?

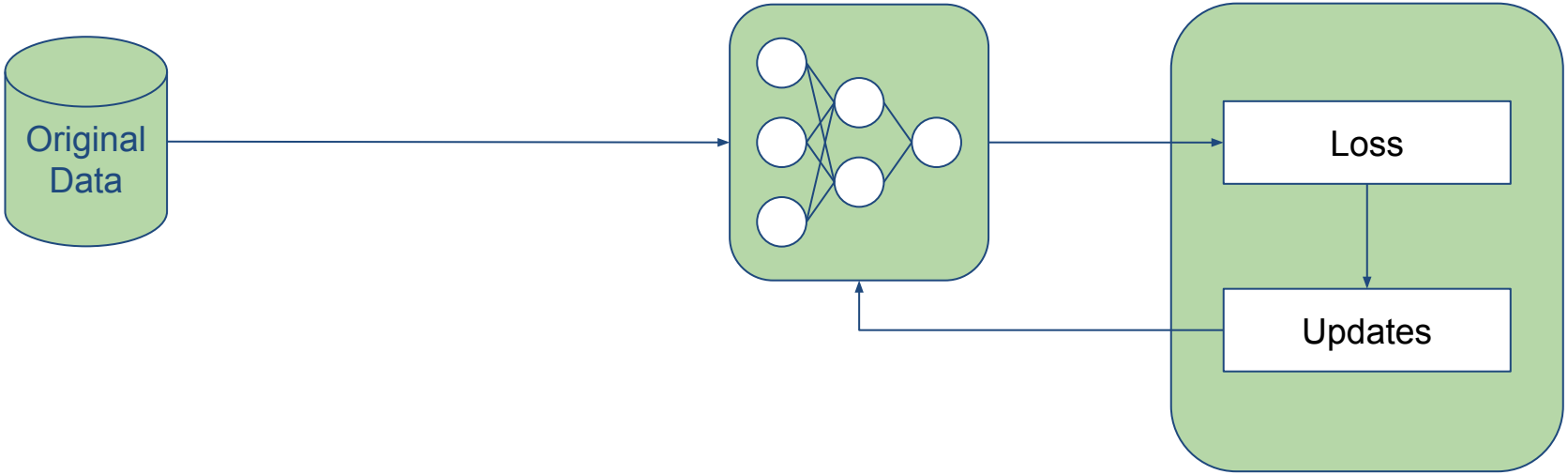
- Feed to your network “new” training data, derived algorithmically
- Deep neural network are always data-hungry
- No data sample is completely “used”
- Computers are stupid

What is data augmentation?

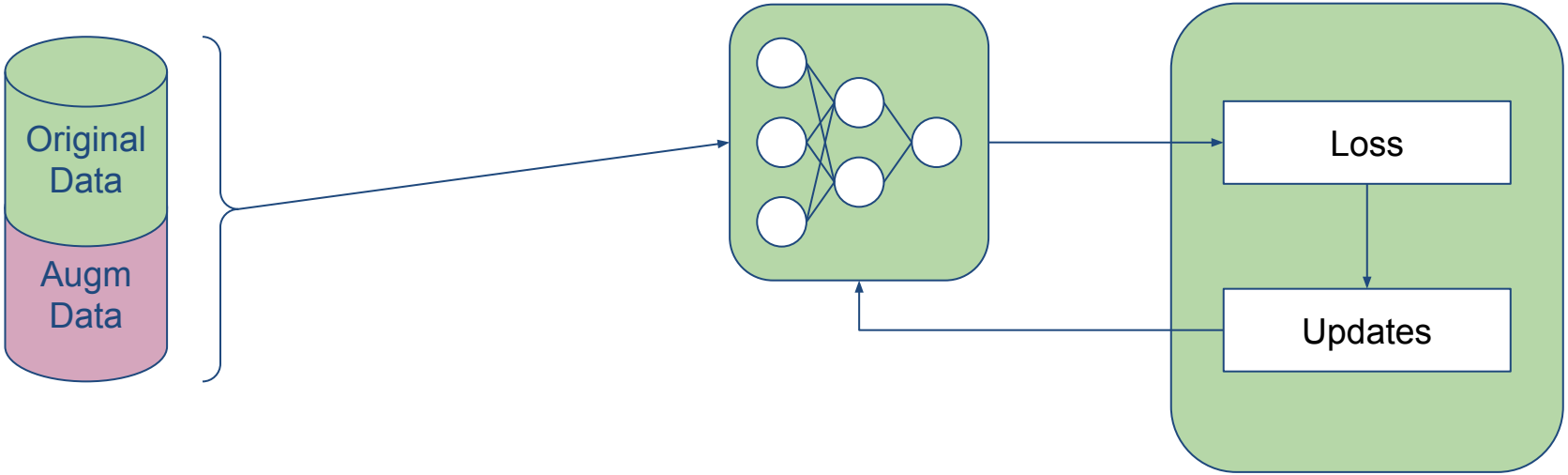
A cat

A completely different cat

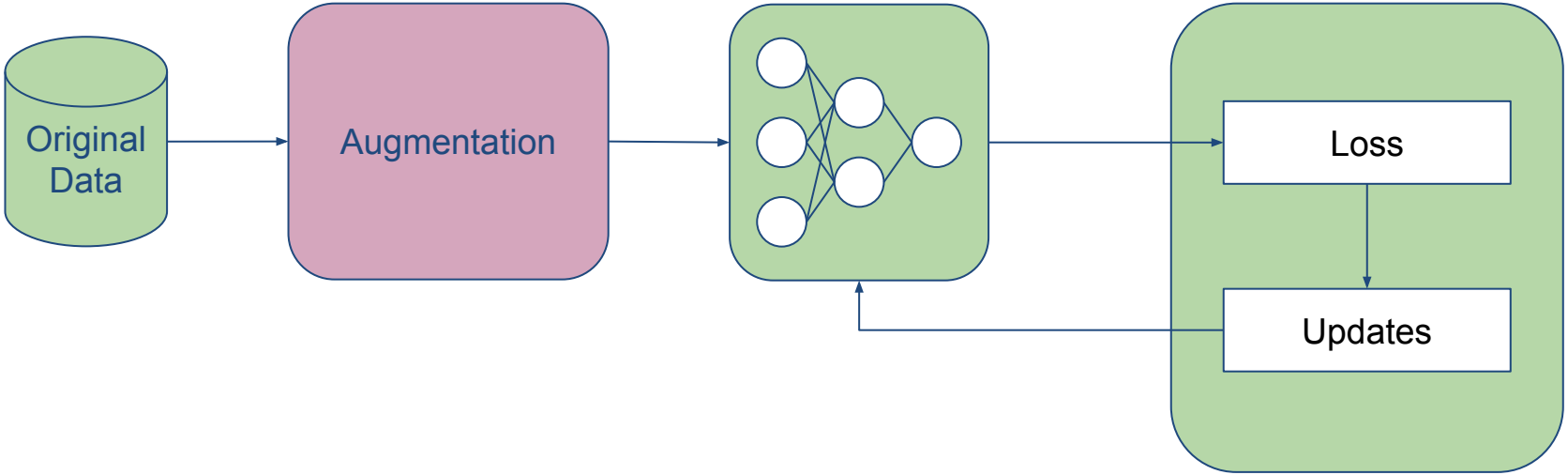
Data augmentation - training baseline



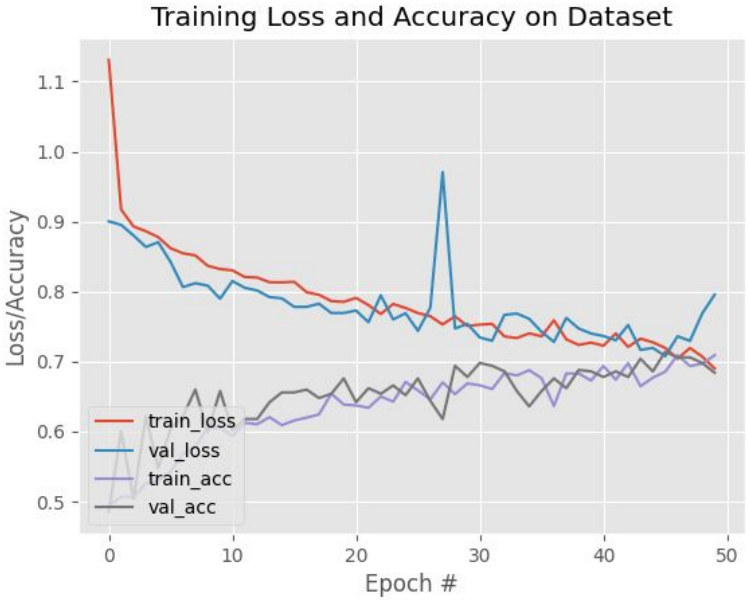
Data augmentation #1: offline



Data augmentation #2: on the fly



Data augmentation effect



Credit: https://www.pyimagesearch.com/2019/07/08/keras-imagedatagenerator-and-data-augmentation/

On-the-fly data augmentation in keras

1) Organize your data properly

```
my_big_data_folder
    train_set
        class_1
            Img1.jpg Img2.jpg Img3.jpg
        class_2
            Img4.jpg Img5.jpg Img6.jpg
        class_3
            Img7.jpg Img8.jpg Img9.jpg
        ...
    test_set
        <same structure, different images>
    val_set
        <same structure, different images>
```

Data augmentation in keras

2) Instantiate two/three ImageDataGenerator

```
from keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(
      rescale=1./255,
      horizontal_flip=True, vertical_flip=True,
      rotation_range=10, width_shift_range=0.2, height_shift_range=0.2,
      ...
)

val_datagen = ImageDataGenerator(rescale=1./255)
```

Data augmentation in keras

3) Give the data to the generator

```
train_generator = train_datagen.flow_from_directory(
      directory = 'my_big_data_folder/train_set',
      target_size = image_shape,
      batch_size = batch_size,
      class_mode = 'categorical'
      ...
)

val_generator = val_datagen.flow_from_directory(
      directory = 'my_big_data_folder/val_set',
      target_size = image_shape,
      batch_size = 5,    #ATTENTION HERE
      class_mode = 'categorical'
      ---
)
```

Data augmentation in keras

4) Train the model

```
history = model.fit(
      x = train_generator,
      validation_data = val_generator,
      epochs = 50,
      ...
)
```

Data augmentation in keras

- Not only from directory:
  - `<your_generator>.flow_from_dataframe(...)`
- Not only images...
  - `from keras.preprocessing.sequence import TimeseriesGenerator`
  - `keras.preprocessing.text...`
- ...but images have way more options

Take home message

- Data augmentation is “free”
  - Extra computational burden is usually minimal
- It does NOT increase the training data size
  - Unless you explicitly do so (offline vs on-the-fly)
- It helps your network to generalize better
- Allows for more training epochs
- It’s almost always a good idea

[REF]

- Keras image data preprocessing: https://keras.io/api/preprocessing/image/
- The different kinds of data augmentation, implemented in a detailed example: https://www.pyimagesearch.com/2019/07/08/keras-imagedatagenerator-and-data-augmentation/
- A gallery of image augmentation: https://machinelearningmastery.com/how-to-configure-image-data-augmentation-when-training-deep-learning-neural-networks/