This notebook contains a generator class for Keras called `BSONIterator` that can read directly from the BSON data. You can use it in combination with `ImageDataGenerator` for doing data augmentation.

start

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
!nvidia-smi
```

```
Fri Sep  9 06:00:08 2022
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla P100-PCIE...  Off  | 00000000:00:04.0 Off |                    0 |
| N/A   41C    P0    27W / 250W |      0MiB / 16280MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

```
! pip install tensorflow==1.15.5
! pip install keras==2.0.8
! pip install tensorflow-gpu==1.15.5
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/publ
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Requirement already satisfied: numpy<1.19.0,>=1.16.0 in /usr/local/lib/python3.7/dist-pa
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Requirement already satisfied: importlib-metadata>=4.4 in /usr/local/lib/python3.7/dist-
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: typing-extensions>=3.6.4 in /usr/local/lib/python3.7/dist
```

```
!pip install kaggle
from google.colab import files
from datetime import datetime
api_token = files.upload()
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/pub
Requirement already satisfied: kaggle in /usr/local/lib/python3.7/dist-packages (1.5.12)
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```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
!mkdir ~/.kaggle
!cp kaggle.json ~/.kaggle/
```

```
!kaggle competitions download -c 'cdiscount-image-classification-challenge' -f train.bson
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you
Downloading train.bson.zip to /content
100% 47.2G/47.2G [05:17<00:00, 151MB/s]
100% 47.2G/47.2G [05:17<00:00, 160MB/s]
```

```
!kaggle competitions download -c 'cdiscount-image-classification-challenge' -f category_names
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you
Downloading category_names.csv to /content
  0% 0.00/406k [00:00<?, ?B/s]
100% 406k/406k [00:00<00:00, 102MB/s]
```

```
!unzip /content/train.bson.zip
```

```
Archive:  /content/train.bson.zip
  inflating: train.bson
```

```
!rm /content/train.bson.zip
```

```
import os, sys, math, io
import numpy as np
import pandas as pd
import multiprocessing as mp
import bson
import struct

%matplotlib inline
import matplotlib.pyplot as plt
```

```
import keras
from keras.preprocessing.image import load_img, img_to_array
import tensorflow as tf

from collections import defaultdict
from tqdm import *

# Input data files are available in the "../input/" directory.
# For example, running this (by clicking run or pressing Shift+Enter) will list the files in

from subprocess import check_output
print(check_output(["ls", "/content"]).decode("utf8"))

# Any results you write to the current directory are saved as output.
```

```
Using TensorFlow backend.
category_names.csv
drive
kaggle.json
sample_data
train.bson
```

```
keras.__version__, tf.__version__
```

```
('2.0.8', '1.15.5')
```

```
import tensorflow as tf
print(tf.__version__, tf.test.is_gpu_available())
```

```
1.15.5 True
```

```
data_dir = "/content"

train_bson_path = os.path.join(data_dir, "train.bson")
num_train_products = 7069896

# train_bson_path = os.path.join(data_dir, "train_example.bson")
# num_train_products = 82

test_bson_path = os.path.join(data_dir, "test.bson")
num_test_products = 1768182
```

Part 1: Create lookup tables

The generator uses several lookup tables that describe the layout of the BSON file, which products and images are part of the training/validation sets, and so on.

You only need to generate these tables once, as they get saved to CSV files. If you already have these CSV files, skip to part 2.

Lookup table for categories

```
categories_path = os.path.join(data_dir, "category_names.csv")
categories_df = pd.read_csv(categories_path, index_col="category_id")

# Maps the category_id to an integer index. This is what we'll use to
# one-hot encode the labels.
categories_df["category_idx"] = pd.Series(range(len(categories_df)), index=categories_df.inde

categories_df.to_csv("categories.csv")
categories_df.head()
```

category_id	category_level1	category_level2	category_level3	category_idx
1000021794	ABONNEMENT / SERVICES	CARTE PREPAYEE	CARTE PREPAYEE MULTIMEDIA	0
1000012764	AMENAGEMENT URBAIN - VOIRIE	AMENAGEMENT URBAIN	ABRI FUMEUR	1
1000012776	AMENAGEMENT URBAIN - VOIRIE	AMENAGEMENT URBAIN	ABRI VELO - ABRI MOTO	2
1000012768	AMENAGEMENT	AMENAGEMENT	FONTAINE A EAU	3

Create dictionaries for quick lookup of `category_id` to `category_idx` mapping.

```
def make_category_tables():
    cat2idx = {}
    idx2cat = {}
    for ir in categories_df.itertuples():
        category_id = ir[0]
        category_idx = ir[4]
        cat2idx[category_id] = category_idx
        idx2cat[category_idx] = category_id
    return cat2idx, idx2cat


cat2idx, idx2cat = make_category_tables()
```

Show hidden output

```
# Test if it works:
```

```
cat2idx[1000012755], idx2cat[4]
```

Read the BSON files

We store the offsets and lengths of all items, allowing us random access to the items later.

Inspired by code from: https://www.kaggle.com/vfdev5/random-item-access

Note: this takes a few minutes to execute, but we only have to do it once (we'll save the table to a CSV file afterwards).

```
def read_bson(bson_path, num_records, with_categories):
    rows = {}
    with open(bson_path, "rb") as f, tqdm(total=num_records) as pbar:
        offset = 0
        while True:
            item_length_bytes = f.read(4)
            if len(item_length_bytes) == 0:
                break

            length = struct.unpack("<i", item_length_bytes)[0]

            f.seek(offset)
            item_data = f.read(length)
            assert len(item_data) == length

            item = bson.BSON.decode(item_data)
            product_id = item["_id"]
            num_imgs = len(item["imgs"])

            row = [num_imgs, offset, length]
            if with_categories:
                row += [item["category_id"]]
            rows[product_id] = row

            offset += length
            f.seek(offset)
            pbar.update()

    columns = ["num_imgs", "offset", "length"]
    if with_categories:
        columns += ["category_id"]

    df = pd.DataFrame.from_dict(rows, orient="index")
    df.index.name = "product_id"
    df.columns = columns
    df.sort_index(inplace=True)
    return df
```

```
%time train_offsets_df = read_bson(train_bson_path, num_records=num_train_products, with_cate
```

```
100%|██████████| 7069896/7069896 [10:21<00:00, 11380.28it/s]
CPU times: user 1min 28s, sys: 25.7 s, total: 1min 53s
Wall time: 10min 30s
```

```
train_offsets_df.to_csv("/content/drive/MyDrive/kerasgenmodel/meta_datatrain_offsets.csv")
```

```
#train_offsets_df.to_csv("/content/drive/MyDrive/kerasgenmodel/meta_datatrain_offsets.csv")
train_offsets_df = pd.read_csv('/content/drive/MyDrive/csvfiles/train_offsets.csv')
```

```
train_offsets_df.head()
```

	product_id	num_imgs	offset	length	category_id
0	0	1	0	6979	1000010653
1	1	1	6979	7318	1000010653
2	2	1	14297	5455	1000004079
3	3	1	19752	4580	1000004141
4	4	1	24332	6346	1000015539

```
#train_offsets_df.to_csv("/content/drive/MyDrive/csvfiles/train_offsets.csv")
```

```
# How many products?
len(train_offsets_df)
```

```
7069896
```

```
# How many categories?
len(train_offsets_df["category_id"].unique())
```

```
5270
```

```
# How many images in total?
train_offsets_df["num_imgs"].sum()
```

```
12371293
```

Create a random train/validation split

We split on products, not on individual images. Since some of the categories only have a few products, we do the split separately for each category.

This creates two new tables, one for the training images and one for the validation images. There is a row for every single image, so if a product has more than one image it occurs more than once in the table.

```
def make_val_set(df, split_percentage=0.2, drop_percentage=0.):
    # Find the product_ids for each category.
    category_dict = defaultdict(list)
    for ir in tqdm(df.itertuples()):
        category_dict[ir[4]].append(ir[0])

    train_list = []
    val_list = []
    with tqdm(total=len(df)) as pbar:
        for category_id, product_ids in category_dict.items():
            category_idx = cat2idx[category_id]

            # Randomly remove products to make the dataset smaller.
            keep_size = int(len(product_ids) * (1. - drop_percentage))
            if keep_size < len(product_ids):
                product_ids = np.random.choice(product_ids, keep_size, replace=False)

            # Randomly choose the products that become part of the validation set.
            val_size = int(len(product_ids) * split_percentage)
            if val_size > 0:
                val_ids = np.random.choice(product_ids, val_size, replace=False)
            else:
                val_ids = []

            # Create a new row for each image.
            for product_id in product_ids:
                row = [product_id, category_idx]
                for img_idx in range(df.loc[product_id, "num_imgs"]):
                    if product_id in val_ids:
                        val_list.append(row + [img_idx])
                    else:
                        train_list.append(row + [img_idx])
                pbar.update()

    columns = ["product_id", "category_idx", "img_idx"]
    train_df = pd.DataFrame(train_list, columns=columns)
    val_df = pd.DataFrame(val_list, columns=columns)
    return train_df, val_df
```

Create a 80/20 split. Also drop 90% of all products to make the dataset more manageable. (Note: if `drop_percentage` > 0, the progress bar doesn't go all the way.)

```
train_images_df, val_images_df = make_val_set(train_offsets_df, split_percentage=0.1,
                                              drop_percentage=0.0)
```

```
train_images_df.head()
```

	product_id	category_idx	img_idx
0	0	5055	0
1	11	5055	0
2	16	5055	0
3	28	5055	0
4	30	5055	0

```
val_images_df.head()
```

```
print("Number of training images:", len(train_images_df))
print("Number of validation images:", len(val_images_df))
print("Total images:", len(train_images_df) + len(val_images_df))
```

```
Number of training images: 11139021
Number of validation images: 1232272
Total images: 12371293
```

Are all categories represented in the train/val split? (Note: if the drop percentage is high, then very small categories won't have enough products left to make it into the validation set.)

```
len(train_images_df["category_idx"].unique()), len(val_images_df["category_idx"].unique())
```

```
(5270, 5270)
```

Quickly verify that the split really is approximately 80-20:

```
category_idx = 619
num_train = np.sum(train_images_df["category_idx"] == category_idx)
num_val = np.sum(val_images_df["category_idx"] == category_idx)
num_val / num_train
```

```
0.11453077699293643
```

Close enough. ;-) Remember that we split on products but not all products have the same number of images, which is where the slightly discrepancy comes from. (Also, there tend to be fewer validation images if `drop_percentage` > 0.)

Save the lookup tables as CSV so that we don't need to repeat the above procedure again.

```
train_images_df.to_csv("train_images.csv")
val_images_df.to_csv("val_images.csv")
```

```
train_images_df.to_csv("/content/drive/MyDrive/kerasgenmodel/meta_data/train_images.csv")
val_images_df.to_csv("/content/drive/MyDrive/kerasgenmodel/meta_data/val_images.csv")
```

Part 2: The generator

First load the lookup tables from the CSV files (you don't need to do this if you just did all the steps from part 1).

```
categories_df = pd.read_csv("/content/drive/MyDrive/kerasgenmodel/meta_data/categories.csv",
cat2idx, idx2cat = make_category_tables()

train_offsets_df = pd.read_csv("/content/drive/MyDrive/kerasgenmodel/meta_datatrain_offsets.c
train_images_df = pd.read_csv("/content/drive/MyDrive/kerasgenmodel/meta_data/train_images.cs
val_images_df = pd.read_csv("/content/drive/MyDrive/kerasgenmodel/meta_data/val_images.csv",
```

Show hidden output

The Keras generator is implemented by the `BSONIterator` class. It creates batches of images (and their one-hot encoded labels) directly from the BSON file. It can be used with multiple workers.

Note: For fastest results, put the train.bson and test.bson files on a fast drive (SSD).

See also the code in: https://github.com/fchollet/keras/blob/master/keras/preprocessing/image.py

```
from keras.preprocessing.image import Iterator
from keras.preprocessing.image import ImageDataGenerator
from keras import backend as K

class BSONIterator(Iterator):
    def __init__(self, bson_file, images_df, offsets_df, num_class,
                 image_data_generator, lock, target_size=(180, 180),
                 with_labels=True, batch_size=32, shuffle=False, seed=None):

        self.file = bson_file
        self.images_df = images_df
        self.offsets_df = offsets_df
        self.with_labels = with_labels
        self.samples = len(images_df)
```

```
            self.num_class = num_class
            self.image_data_generator = image_data_generator
            self.target_size = tuple(target_size)
            self.image_shape = self.target_size + (3,)

            print("Found %d images belonging to %d classes." % (self.samples, self.num_class))

            super(BSONIterator, self).__init__(self.samples, batch_size, shuffle, seed)
            self.lock = lock

        def _get_batches_of_transformed_samples(self, index_array):
            batch_x = np.zeros((len(index_array),) + self.image_shape, dtype=K.floatx())
            if self.with_labels:
                batch_y = np.zeros((len(batch_x), self.num_class), dtype=K.floatx())

            for i, j in enumerate(index_array):
                # Protect file and dataframe access with a lock.
                with self.lock:
                    image_row = self.images_df.iloc[j]
                    product_id = image_row["product_id"]
                    offset_row = self.offsets_df.loc[product_id]

                    # Read this product's data from the BSON file.
                    self.file.seek(offset_row["offset"])
                    item_data = self.file.read(offset_row["length"])

                # Grab the image from the product.
                item = bson.BSON.decode(item_data)
                img_idx = image_row["img_idx"]
                bson_img = item["imgs"][img_idx]["picture"]

                # Load the image.
                img = load_img(io.BytesIO(bson_img), target_size=self.target_size)

                # Preprocess the image.
                x = img_to_array(img)
                x = self.image_data_generator.random_transform(x)
                x = self.image_data_generator.standardize(x)

                # Add the image and the label to the batch (one-hot encoded).
                batch_x[i] = x
                if self.with_labels:
                    batch_y[i, image_row["category_idx"]] = 1

            if self.with_labels:
                return batch_x, batch_y
            else:
                return batch_x

        def next(self):
            with self.lock:
```

```
            index_array = next(self.index_generator)
        return self._get_batches_of_transformed_samples(index_array[0])
```

```
train_bson_file = open(train_bson_path, "rb")
```

Because the training and validation generators read from the same BSON file, they need to use the same lock to protect it.

```
import threading
lock = threading.Lock()
```

Create a generator for training and a generator for validation.

```
num_classes = 5270
num_train_images = len(train_images_df)
num_val_images = len(val_images_df)
batch_size = 300

# Tip: use ImageDataGenerator for data augmentation and preprocessing.
train_datagen = ImageDataGenerator(rescale=1./255)
train_gen = BSONIterator(train_bson_file, train_images_df, train_offsets_df,
                         num_classes, train_datagen, lock,
                         batch_size=batch_size, shuffle=True)

val_datagen = ImageDataGenerator(rescale=1./255)
val_gen = BSONIterator(train_bson_file, val_images_df, train_offsets_df,
                       num_classes, val_datagen, lock,
                       batch_size=batch_size, shuffle=True)
```

```
    Found 11139021 images belonging to 5270 classes.
    Found 1232272 images belonging to 5270 classes.
```

```
next(train_gen)  # warm-up

%time bx, by = next(train_gen)
```

```
    CPU times: user 416 ms, sys: 38.3 ms, total: 454 ms
    Wall time: 1.07 s
```

```
#Found 989740 images belonging to 5270 classes.
#Found 242058 images belonging to 5270 classes.
```

```
# prepare data augmentation configuration
#train_datagen = ImageDataGenerator(
```

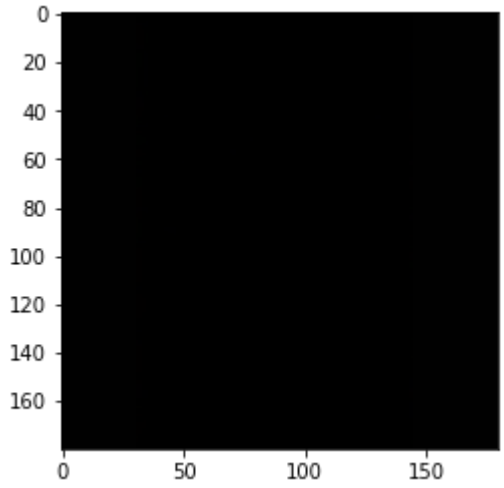
```
#         rescale=1./255,
#         shear_range=0.2,
#         zoom_range=0.2,
#         horizontal_flip=True)
```

How fast is the generator? Create a single batch:

Does it really output images and one-hot encoded class labels? Note that the images are pre-processed (and augmented) and therefore may look weird.

```
plt.imshow(bx[-1].astype(np.uint8))
```

```
<matplotlib.image.AxesImage at 0x7f74e4aed9d0>
```




```
cat_idx = np.argmax(by[-1])
cat_id = idx2cat[cat_idx]
categories_df.loc[cat_id]
```

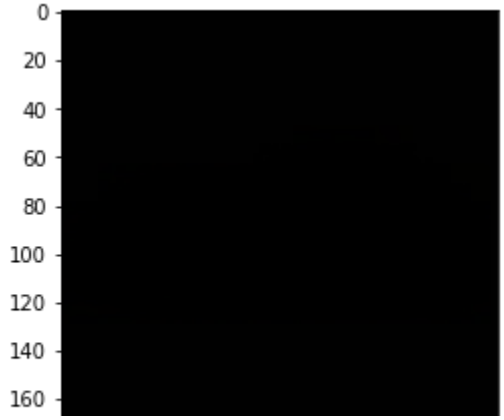
```
category_level1                              LIBRAIRIE
category_level2    BRICOLAGE - DECORATION - JARDINAGE
category_level3                             BRICOLAGE
category_idx                                      3259
Name: 1000014058, dtype: object
```

```
%time bx, by = next(val_gen)
```

```
CPU times: user 429 ms, sys: 90 ms, total: 519 ms
Wall time: 1.03 s
```

```
plt.imshow(bx[-1].astype(np.uint8))
```

```
<matplotlib.image.AxesImage at 0x7f74e45dfd90>
```




```
cat_idx = np.argmax(by[-1])
cat_id = idx2cat[cat_idx]
categories_df.loc[cat_id]
```

```
category_level1                                                SPORT
category_level2                                  RUNNING - ATHLETISME
category_level3    CHAUSSURES DE RUNNING - CHAUSSURES D'ATHLETISME
category_idx                                                  4798
Name: 1000018838, dtype: object
```

Part 3: Training

Create a very simple Keras model and train it, to test that the generators work.

```
from keras.models import Sequential
from keras.layers import Dropout, Flatten, Dense
from keras.layers.convolutional import Conv2D
from keras.layers.pooling import MaxPooling2D, GlobalAveragePooling2D

model = Sequential()
model.add(Conv2D(32, 3, padding="same", activation="relu", input_shape=(180, 180, 3)))
model.add(MaxPooling2D())
model.add(Conv2D(64, 3, padding="same", activation="relu"))
model.add(MaxPooling2D())
model.add(Conv2D(128, 3, padding="same", activation="relu"))
model.add(MaxPooling2D(2,2))
model.add(GlobalAveragePooling2D())
model.add(Dense(num_classes, activation="softmax"))

model.compile(optimizer="adam",
              loss="categorical_crossentropy",
              metrics=["accuracy"])

model.summary()
```

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_4 (Conv2D)            (None, 180, 180, 32)      896
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 90, 90, 32)        0
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 90, 90, 64)        18496
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 45, 45, 64)        0
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 45, 45, 128)       73856
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 22, 22, 128)       0
_________________________________________________________________
global_average_pooling2d_2 ( (None, 128)               0
_________________________________________________________________
dense_2 (Dense)              (None, 5270)              679830
=================================================================
Total params: 773,078
Trainable params: 773,078
Non-trainable params: 0
_________________________________________________________________
```

```
# To train the model:
model.fit_generator(train_gen,
                    steps_per_epoch = 50,   #num_train_images // batch_size,
                    epochs = 1,
                    validation_data = val_gen,
                    validation_steps = 10,  #num_val_images // batch_size,
                    workers = 8)
```

```
Epoch 1/1
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

50/50 [==============================] - 564s - loss: 7.4456 - acc: 0.0059 - val_loss: 1
<keras.callbacks.History at 0x7f07a0971790>
```

```
model.save('/content/model',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

```
from keras.models import load_model
demo = load_model('/content/model')
```

```
# To train the model:
demo.fit_generator(train_gen,
                   steps_per_epoch = 50,   #num_train_images // batch_size,
                   epochs = 3,
                   validation_data = val_gen,
                   validation_steps = 10,  #num_val_images // batch_size,
                   workers = 8)
```

```
Epoch 1/3
50/50 [==============================] - 363s - loss: 6.9756 - acc: 0.0076 - val_loss: 1
Epoch 2/3
50/50 [==============================] - 323s - loss: 6.8859 - acc: 0.0101 - val_loss: 1
Epoch 3/3
50/50 [==============================] - 342s - loss: 6.8476 - acc: 0.0113 - val_loss: 1
<keras.callbacks.History at 0x7f079e6b78d0>
```

```
model.save('/content/model2',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

```
from keras.models import load_model
demo2 = load_model('/content/model2')
```

```
# To train the model:
demo2.fit_generator(train_gen,
                   steps_per_epoch = 50,   #num_train_images // batch_size,
                   epochs = 3,
                   validation_data = val_gen,
                   validation_steps = 10,  #num_val_images // batch_size,
                   workers = 8)
```

```
Epoch 1/3
29/50 [=================>............] - ETA: 138s - loss: 7.6707 - acc: 0.0054
```

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
```

```
# To evaluate on the validation set:
#model.evaluate_generator(val_gen, steps=num_val_images // batch_size, workers=8)
```

```
----> 7                       workers = 8)
```

```
def lr_scheduler(epoch, lr):
    'For every 2nd epoch, decay learning rate by 5%'
    decay_rate = .95
    decay_step = 1
    if (epoch+1) % decay_step == 0 :
        return lr * decay_rate
    return lr
```

```
from keras.callbacks import ReduceLROnPlateau
from keras.callbacks import LearningRateScheduler

reduce_lr = ReduceLROnPlateau(monitor='val_acc', factor=0.2, patience=1, min_lr=0.0000000003)

#lrschedule = LearningRateScheduler(lr_scheduler)
```

```
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
from keras.applications.vgg16 import VGG16
from keras.applications.vgg16 import preprocess_input
from keras.preprocessing import image
from keras.layers import Dense, Conv2D, MaxPool2D , Flatten
from keras.callbacks import Callback
from keras.callbacks import TensorBoard
```

```
from keras.applications.xception import Xception
from keras.applications.xception import preprocess_input
```

```
IMAGE_SIZE = [180, 180] #pre trained Xception model
model = Xception(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

Downloading data from https://github.com/fchollet/deep-learning-models/releases/downloa
```

```
79699968/83683744 [===========================>..] - ETA: 0sWARNING:tensorflow:From /usr

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
#model_1
for layer in model.layers:
  layer.trainable = False
#Adding custom Layers
x = model.output
x = Conv2D(filters=512,kernel_size=(3,3),padding="same", activation="relu")(x)
x = MaxPool2D(2,2)(x)
x = Flatten()(x)
x = Dense(500, activation="relu")(x)
x = Dense(500, activation="relu")(x)
output = Dense(5270, activation="softmax")(x)
# creating the final model
model_1 = Model(inputs = model.input, outputs = output)
# compile the model
Adam = keras.optimizers.Adam(lr=0.0003, beta_1=0.9, beta_2=0.999, epsilon=1e-07)
model_1.compile(loss = "categorical_crossentropy", optimizer = Adam, metrics=["accuracy"])
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
model_1.summary()
```

```
_________________________________________________________________
block5_sepconv1 (SeparableConv2D (None, 11, 11, 728)   536536      block5_sepconv1_ac
_________________________________________________________________
block5_sepconv1_bn (BatchNormali (None, 11, 11, 728)   2912        block5_sepconv1[0]
_________________________________________________________________
block5_sepconv2_act (Activation) (None, 11, 11, 728)   0           block5_sepconv1_bn
_________________________________________________________________
block5_sepconv2 (SeparableConv2D (None, 11, 11, 728)   536536      block5_sepconv2_ac
_________________________________________________________________
block5_sepconv2_bn (BatchNormali (None, 11, 11, 728)   2912        block5_sepconv2[0]
_________________________________________________________________
```

```
block5_sepconv3_act (Activation) (None, 11, 11, 728)   0           block5_sepconv2_bn
__________________________________________________________________________________________
block5_sepconv3 (SeparableConv2D (None, 11, 11, 728)   536536      block5_sepconv3_ac
__________________________________________________________________________________________
block5_sepconv3_bn (BatchNormali (None, 11, 11, 728)   2912        block5_sepconv3[0]
__________________________________________________________________________________________
add_4 (Add)                      (None, 11, 11, 728)   0           block5_sepconv3_bn
                                                                   add_3[0][0]
__________________________________________________________________________________________
block6_sepconv1_act (Activation) (None, 11, 11, 728)   0           add_4[0][0]
__________________________________________________________________________________________
block6_sepconv1 (SeparableConv2D (None, 11, 11, 728)   536536      block6_sepconv1_ac
__________________________________________________________________________________________
block6_sepconv1_bn (BatchNormali (None, 11, 11, 728)   2912        block6_sepconv1[0]
__________________________________________________________________________________________
block6_sepconv2_act (Activation) (None, 11, 11, 728)   0           block6_sepconv1_bn
__________________________________________________________________________________________
block6_sepconv2 (SeparableConv2D (None, 11, 11, 728)   536536      block6_sepconv2_ac
__________________________________________________________________________________________
block6_sepconv2_bn (BatchNormali (None, 11, 11, 728)   2912        block6_sepconv2[0]
__________________________________________________________________________________________
block6_sepconv3_act (Activation) (None, 11, 11, 728)   0           block6_sepconv2_bn
__________________________________________________________________________________________
block6_sepconv3 (SeparableConv2D (None, 11, 11, 728)   536536      block6_sepconv3_ac
__________________________________________________________________________________________
block6_sepconv3_bn (BatchNormali (None, 11, 11, 728)   2912        block6_sepconv3[0]
__________________________________________________________________________________________
add_5 (Add)                      (None, 11, 11, 728)   0           block6_sepconv3_bn
                                                                   add_4[0][0]
__________________________________________________________________________________________
block7_sepconv1_act (Activation) (None, 11, 11, 728)   0           add_5[0][0]
__________________________________________________________________________________________
block7_sepconv1 (SeparableConv2D (None, 11, 11, 728)   536536      block7_sepconv1_ac
__________________________________________________________________________________________
block7_sepconv1_bn (BatchNormali (None, 11, 11, 728)   2912        block7_sepconv1[0]
__________________________________________________________________________________________
block7_sepconv2_act (Activation) (None, 11, 11, 728)   0           block7_sepconv1_bn
__________________________________________________________________________________________
block7_sepconv2 (SeparableConv2D (None, 11, 11, 728)   536536      block7_sepconv2_ac
__________________________________________________________________________________________
block7_sepconv2_bn (BatchNormali (None, 11, 11, 728)   2912        block7_sepconv2[0]
__________________________________________________________________________________________
block7_sepconv3_act (Activation) (None, 11, 11, 728)   0           block7_sepconv2_bn
__________________________________________________________________________________________
block7_sepconv3 (SeparableConv2D (None, 11, 11, 728)   536536      block7_sepconv3_ac
__________________________________________________________________________________________
block7_sepconv3_bn (BatchNormali (None, 11, 11, 728)   2912        block7_sepconv3[0]
```

```
# To train the model:
model_1.fit_generator(train_gen,
                      steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                      epochs = 1,
                      validation_data = val_gen,
```

```
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8)
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

Epoch 1/1
37130/37130 [==============================] - 27517s - loss: 2.9607 - acc: 0.4601 - val
<keras.callbacks.History at 0x7f596698aa10>
```

```
model_1.save('/content/drive/MyDrive/kerasep1_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

```
model_1.save_weights('/content/drive/MyDrive/kerasmodelep1_weight')
print("Wights Saved")
```

```
Wights Saved
```

```
from keras.models import load_model
demo2 = load_model('/content/drive/MyDrive/kerasep1_model.kerasave')
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
keras.backend.set_value(demo2.optimizer.lr, 0.0003)
```

```
demo2.optimizer.get_config()
```

```
{'lr': 0.0003000000142492354,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
# To train the model:
demo2.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 2,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/2
37130/37130 [==============================] - 27757s - loss: 2.5840 - acc: 0.5098 - val
  (self.monitor, ','.join(list(logs.keys()))), RuntimeWarning

Epoch 2/2
37130/37130 [==============================] - 27764s - loss: 2.4930 - acc: 0.5228 - val
<keras.callbacks.History at 0x7fdb7257e910>
```

```
demo2.save('/content/drive/MyDrive/kerasep3_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

```
model_1.save_weights('/content/drive/MyDrive/kerasmodelep3_weight')
print("Wights Saved")
```

```
from keras.models import load_model
demo2 = load_model('/content/drive/MyDrive/kerasep3_model.kerasave')
```

```
# To train the model:
demo2.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 2,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/2
37130/37130 [==============================] - 27658s - loss: 2.4442 - acc: 0.5298 - val
Epoch 2/2
37130/37130 [==============================] - 27675s - loss: 2.4123 - acc: 0.5344 - val
<keras.callbacks.History at 0x7f9ff1f87510>
```

```
demo2.save('/content/drive/MyDrive/kerasep4_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

Double-click (or enter) to edit

```
from keras.models import load_model
demo2 = load_model('/content/drive/MyDrive/kerasep5_model.kerasave')
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
demo2.optimizer.get_config()
```

```
{'lr': 0.0003000000142492354,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
0.0003*0.65
```

```
0.000195
```

```
keras.backend.set_value(demo2.optimizer.lr, 0.000195)
```

```
demo2.optimizer.get_config()
```

```
{'lr': 0.00019500000053085387,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
# To train the model:
```

```
demo2.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 3,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/3
37130/37130 [==============================] - 27764s - loss: 2.2950 - acc: 0.5504 - val
  (self.monitor, ','.join(list(logs.keys()))), RuntimeWarning

Epoch 2/3
37130/37130 [==============================] - 27759s - loss: 2.2476 - acc: 0.5567 - val
Epoch 3/3
37130/37130 [==============================] - 27760s - loss: 2.2218 - acc: 0.5600 - val
<keras.callbacks.History at 0x7f75a02644d0>
```

```
demo2.save('/content/drive/MyDrive/kerasep8_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

lr 0.00005

```
from keras.models import load_model
demo2 = load_model('/content/drive/MyDrive/kerasep8_model.kerasave')
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
demo2.optimizer.get_config()
```

```
{'lr': 0.00019500000053085387,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
keras.backend.set_value(demo2.optimizer.lr, 0.00005)
```

```
demo2.optimizer.get_config()
```

```
{'lr': 4.999999873689376e-05,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
# To train the model:
demo2.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 3,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/3
37130/37130 [==============================] - 27458s - loss: 2.0836 - acc: 0.5791 - val
Epoch 2/3
37130/37130 [==============================] - 27392s - loss: 2.0411 - acc: 0.5849 - val
```

```
Epoch 3/3
37130/37130 [==============================] - 27400s - loss: 2.0189 - acc: 0.5879 - val
<keras.callbacks.History at 0x7f8ef5362d90>
```

```
demo2.save('/content/drive/MyDrive/kerasep11_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

Double-click (or enter) to edit

```
from keras.models import load_model
demo2 = load_model('/content/drive/MyDrive/kerasep11_model.kerasave')
```

```
demo2.optimizer.get_config()
```

```
keras.backend.set_value(demo2.optimizer.lr, 0.000005)
```

```
demo2.optimizer.get_config()
```

```
# To train the model:
demo2.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 1,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/1
37130/37130 [==============================] - 27535s - loss: 1.9701 - acc: 0.5944 - val
<keras.callbacks.History at 0x7fc64a02ac10>
```

```
demo2.save('/content/drive/MyDrive/kerasep12_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

n

```
from keras.models import load_model
```

```
model = load_model('/content/drive/MyDrive/kerasep12_model.kerasave')
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
model.summary()
```

```
_________________________________________________________________________________________
Layer (type)                 Output Shape              Param #     Connected to
=========================================================================================
input_1 (InputLayer)         (None, 180, 180, 3)       0
_________________________________________________________________________________________
block1_conv1 (Conv2D)        (None, 89, 89, 32)        864         input_1[0][0]
_________________________________________________________________________________________
block1_conv1_bn (BatchNormalizat (None, 89, 89, 32)    128         block1_conv1[0][0]
_________________________________________________________________________________________
block1_conv1_act (Activation)    (None, 89, 89, 32)    0           block1_conv1_bn[0]
_________________________________________________________________________________________
block1_conv2 (Conv2D)        (None, 87, 87, 64)        18432       block1_conv1_act[0
_________________________________________________________________________________________
block1_conv2_bn (BatchNormalizat (None, 87, 87, 64)    256         block1_conv2[0][0]
_________________________________________________________________________________________
block1_conv2_act (Activation)    (None, 87, 87, 64)    0           block1_conv2_bn[0]
_________________________________________________________________________________________
block2_sepconv1 (SeparableConv2D (None, 87, 87, 128)   8768        block1_conv2_act[0
_________________________________________________________________________________________
block2_sepconv1_bn (BatchNormali (None, 87, 87, 128)   512         block2_sepconv1[0]
_________________________________________________________________________________________
block2_sepconv2_act (Activation) (None, 87, 87, 128)   0           block2_sepconv1_bn
_________________________________________________________________________________________
block2_sepconv2 (SeparableConv2D (None, 87, 87, 128)   17536       block2_sepconv2_ac
_________________________________________________________________________________________
block2_sepconv2_bn (BatchNormali (None, 87, 87, 128)   512         block2_sepconv2[0]
_________________________________________________________________________________________
conv2d_1 (Conv2D)            (None, 44, 44, 128)       8192        block1_conv2_act[0
_________________________________________________________________________________________
block2_pool (MaxPooling2D)       (None, 44, 44, 128)   0           block2_sepconv2_bn
_________________________________________________________________________________________
batch_normalization_1 (BatchNorm (None, 44, 44, 128)   512         conv2d_1[0][0]
```

```
add_1 (Add)                     (None, 44, 44, 128)   0           block2_pool[0][0]
                                                                  batch_normalizatio
block3_sepconv1_act (Activation) (None, 44, 44, 128)  0           add_1[0][0]
block3_sepconv1 (SeparableConv2D (None, 44, 44, 256)  33920       block3_sepconv1_ac
block3_sepconv1_bn (BatchNormali (None, 44, 44, 256)  1024        block3_sepconv1[0]
block3_sepconv2_act (Activation) (None, 44, 44, 256)  0           block3_sepconv1_bn
block3_sepconv2 (SeparableConv2D (None, 44, 44, 256)  67840       block3_sepconv2_ac
block3_sepconv2_bn (BatchNormali (None, 44, 44, 256)  1024        block3_sepconv2[0]
conv2d_2 (Conv2D)               (None, 22, 22, 256)   32768       add_1[0][0]
block3_pool (MaxPooling2D)      (None, 22, 22, 256)   0           block3_sepconv2_bn
batch_normalization_2 (BatchNorm (None, 22, 22, 256)  1024        conv2d_2[0][0]
add_2 (Add)                     (None, 22, 22, 256)   0           block3_pool[0][0]
                                                                  batch_normalizatio
```

set last 3 layer of xception net to trainable

```
my_layer = model.get_layer('block14_sepconv2')
my_layer.trainable = True


my_layer = model.get_layer('block14_sepconv2_bn')
my_layer.trainable = True


my_layer = model.get_layer('block14_sepconv2_act')
my_layer.trainable = True


model.summary()
```

```
Layer (type)                 Output Shape              Param #     Connected to
==================================================================================
input_1 (InputLayer)         (None, 180, 180, 3)       0
block1_conv1 (Conv2D)        (None, 89, 89, 32)        864         input_1[0][0]
block1_conv1_bn (BatchNormalizat (None, 89, 89, 32)    128         block1_conv1[0][0]
block1_conv1_act (Activation) (None, 89, 89, 32)       0           block1_conv1_bn[0]
```

```
block1_conv2 (Conv2D)           (None, 87, 87, 64)   18432       block1_conv1_act[0
block1_conv2_bn (BatchNormalizat (None, 87, 87, 64)   256         block1_conv2[0][0]
block1_conv2_act (Activation)   (None, 87, 87, 64)   0           block1_conv2_bn[0]
block2_sepconv1 (SeparableConv2D (None, 87, 87, 128)  8768        block1_conv2_act[0
block2_sepconv1_bn (BatchNormali (None, 87, 87, 128)  512         block2_sepconv1[0]
block2_sepconv2_act (Activation) (None, 87, 87, 128)  0           block2_sepconv1_bn
block2_sepconv2 (SeparableConv2D (None, 87, 87, 128)  17536       block2_sepconv2_ac
block2_sepconv2_bn (BatchNormali (None, 87, 87, 128)  512         block2_sepconv2[0]
conv2d_1 (Conv2D)               (None, 44, 44, 128)  8192        block1_conv2_act[0
block2_pool (MaxPooling2D)      (None, 44, 44, 128)  0           block2_sepconv2_bn
batch_normalization_1 (BatchNorm (None, 44, 44, 128)  512         conv2d_1[0][0]
add_1 (Add)                     (None, 44, 44, 128)  0           block2_pool[0][0]
                                                                 batch_normalizatio
block3_sepconv1_act (Activation) (None, 44, 44, 128)  0           add_1[0][0]
block3_sepconv1 (SeparableConv2D (None, 44, 44, 256)  33920       block3_sepconv1_ac
block3_sepconv1_bn (BatchNormali (None, 44, 44, 256)  1024        block3_sepconv1[0]
block3_sepconv2_act (Activation) (None, 44, 44, 256)  0           block3_sepconv1_bn
block3_sepconv2 (SeparableConv2D (None, 44, 44, 256)  67840       block3_sepconv2_ac
block3_sepconv2_bn (BatchNormali (None, 44, 44, 256)  1024        block3_sepconv2[0]
conv2d_2 (Conv2D)               (None, 22, 22, 256)  32768       add_1[0][0]
block3_pool (MaxPooling2D)      (None, 22, 22, 256)  0           block3_sepconv2_bn
batch_normalization_2 (BatchNorm (None, 22, 22, 256)  1024        conv2d_2[0][0]
add_2 (Add)                     (None, 22, 22, 256)  0           block3_pool[0][0]
                                                                 batch_normalizatio
```

```
model.optimizer.get_config()
```

```
{'lr': 4.999999873689376e-06,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
keras.backend.set_value(model.optimizer.lr, 0.0001)
```

```
model.optimizer.get_config()
```

```
{'lr': 9.999999747378752e-05,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
# To train the model:
model.fit_generator(train_gen,
                    steps_per_epoch = num_train_images // batch_size,   #num_train_images //
                    epochs = 2,
                    validation_data = val_gen,
                    validation_steps = num_val_images // batch_size,  #num_val_images // batc
                    workers = 8,
                    callbacks= [reduce_lr])
```

```
Epoch 1/2
37130/37130 [==============================] - 27447s - loss: 2.0486 - acc: 0.5834 - val
Epoch 2/2
37130/37130 [==============================] - 27441s - loss: 2.0400 - acc: 0.5845 - val
<keras.callbacks.History at 0x7fa0d7333b90>
```

```
model.save('/content/drive/MyDrive/kerasep14_model.kerasave',include_optimizer=True)
print("Model Saved")
```

```
Model Saved
```

Double-click (or enter) to edit

```
from keras.models import load_model
model2 = load_model('/content/drive/MyDrive/kerasep14_model.kerasave')
```

```
/usr/local/lib/python3.7/dist-packages/keras/models.py:287: UserWarning: Error in loadir
  warnings.warn('Error in loading the saved optimizer '
```

```
model2.optimizer.get_config()
```

```
{'lr': 9.999999747378752e-05,
 'beta_1': 0.8999999761581421,
 'beta_2': 0.9990000128746033,
 'decay': 0.0,
 'epsilon': 1e-07}
```

```
keras.backend.set_value(model.optimizer.lr, 0.00005)
```

Prediction

```
!kaggle competitions download -c 'cdiscount-image-classification-challenge' -f test.bson
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you
Downloading test.bson.zip to /content
100% 11.8G/11.8G [02:33<00:00, 74.5MB/s]
100% 11.8G/11.8G [02:33<00:00, 82.5MB/s]
```

```
!unzip /content/test.bson.zip
```

```
Archive:  /content/test.bson.zip
  inflating: test.bson
```

```
!rm /content/test.bson.zip
```

```
!kaggle competitions download -c 'cdiscount-image-classification-challenge' -f sample_submiss
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you
Downloading sample_submission.csv.zip to /content
100% 4.61M/4.61M [00:00<00:00, 28.5MB/s]
100% 4.61M/4.61M [00:00<00:00, 28.4MB/s]
```

```
!unzip /content/sample_submission.csv.zip
```

```
Archive:  /content/sample_submission.csv.zip
  inflating: sample_submission.csv
```

```
from keras.models import load_model
model = load_model('/content/drive/MyDrive/kerasep12_model.kerasave')
```

```
Using TensorFlow backend.
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
```

```
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/optimizers.py:711:

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
keep_dims is deprecated, use keepdims instead
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/python/op
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_

WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the construct
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/keras/backend/tensorflow_
```

```
from keras import backend as K
from keras.preprocessing.image import ImageDataGenerator
from keras.models import load_model
import pandas as pd
import bson
import os
from collections import defaultdict
from tqdm import *
import multiprocessing as mp
import struct
import os, sys, math, io
import numpy as np
from keras.preprocessing.image import load_img, img_to_array

num_test_products = 1768182


categories_path = os.path.join("/content/drive/Shareddrives/Case_study/cdiscount/category_nam
categories_df = pd.read_csv(categories_path, index_col="category_id")

# Maps the category_id to an integer index. This is what we'll use to
# one-hot encode the labels.
categories_df["category_idx"] = pd.Series(range(len(categories_df)), index=categories_df.inde
```

```
categories_df.to_csv("categories.csv")
categories_df.head()

def make_category_tables():
    cat2idx = {}
    idx2cat = {}
    for ir in categories_df.itertuples():
        category_id = ir[0]
        category_idx = ir[4]
        cat2idx[category_id] = category_idx
        idx2cat[category_idx] = category_id
    return cat2idx, idx2cat

cat2idx, idx2cat = make_category_tables()

submission_df = pd.read_csv("/content/sample_submission.csv")
submission_df.head()

test_bson_path = os.path.join("/content/test.bson")

# test_datagen = ImageDataGenerator(
#         rescale=1./255,
#         shear_range=0.2,
#         zoom_range=0.3,
#         rotation_range=180.,
#         width_shift_range=0.3,
#         height_shift_range=0.3,
#         horizontal_flip=True)

test_datagen = ImageDataGenerator(
         rescale=1./255)

data = bson.decode_file_iter(open(test_bson_path, "rb"))

with tqdm(total=num_test_products) as pbar:
    for c, d in enumerate(data):
        product_id = d["_id"]
        num_imgs = len(d["imgs"])
        batch_x = np.zeros((num_imgs, 180, 180, 3), dtype=K.floatx())
        for i in range(num_imgs):
            bson_img = d["imgs"][i]["picture"]
            # Load and preprocess the image.
            img = load_img(io.BytesIO(bson_img), target_size=(180, 180))
            x = img_to_array(img)
            #x = test_datagen.random_transform(x)
            x = test_datagen.standardize(x)
            # Add the image to the batch.
            batch_x[i] = x
        prediction = model.predict(batch_x, batch_size=num_imgs)
        avg_pred = prediction.mean(axis=0) # .mean
        cat_idx = np.argmax(avg_pred)
        submission_df.iloc[c]["category_id"] = idx2cat[cat_idx]
```

```
        pbar.update()

submission_df.to_csv("final_submission.csv.gz", compression="gzip", index=False)
```

```
    100%|██████████| 1768182/1768182 [7:40:13<00:00, 64.03it/s]
```

```
import shutil

# Source path 100006949
source = "/content/final_submission.csv.gz"

# Destination path
destination = "/content/drive/MyDrive"

# Move the content of
# source to destination
dest = shutil.move(source, destination)
print('done')
```

```
    done
```