## Animals 90 Pytorch Lightning CNN

```
import os
import random
import numpy as np
import pandas as pd
from tqdm import tqdm
import torch
import torch.nn as nn
import torch.nn.functional as F
from torch.utils.data import random_split
from torch.utils.data import DataLoader, Dataset, Subset
from torch.utils.data import random_split, SubsetRandomSampler
from torchvision import datasets, transforms, models
from torchvision.datasets import ImageFolder
from torchvision.transforms import ToTensor
from torchvision.utils import make_grid
from pytorch_lightning import LightningModule
from pytorch_lightning import Trainer
import pytorch_lightning as pl
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
from PIL import Image
```

```
transform=transforms.Compose([
        transforms.RandomRotation(10),      # rotate +/- 10 degrees
        transforms.RandomHorizontalFlip(),  # reverse 50% of images
        transforms.Resize(224),             # resize shortest side to
224 pixels
        transforms.CenterCrop(224),         # crop longest side to 224
pixels at center
        transforms.ToTensor(),
        transforms.Normalize([0.485, 0.456, 0.406],
                             [0.229, 0.224, 0.225])
])
```

```
dataset0=datasets.ImageFolder(root="/kaggle/input/animal-image-
dataset-90-different-animals/animals/animals",transform=None)
```

```
class_names=dataset0.classes
print(class_names)
print(len(class_names))
```

```
['antelope', 'badger', 'bat', 'bear', 'bee', 'beetle', 'bison',
'boar', 'butterfly', 'cat', 'caterpillar', 'chimpanzee', 'cockroach',
'cow', 'coyote', 'crab', 'crow', 'deer', 'dog', 'dolphin', 'donkey',
'dragonfly', 'duck', 'eagle', 'elephant', 'flamingo', 'fly', 'fox',
'goat', 'goldfish', 'goose', 'gorilla', 'grasshopper', 'hamster',
'hare', 'hedgehog', 'hippopotamus', 'hornbill', 'horse',
'hummingbird', 'hyena', 'jellyfish', 'kangaroo', 'koala', 'ladybugs',
'leopard', 'lion', 'lizard', 'lobster', 'mosquito', 'moth', 'mouse',
'octopus', 'okapi', 'orangutan', 'otter', 'owl', 'ox', 'oyster',
'panda', 'parrot', 'pelecaniformes', 'penguin', 'pig', 'pigeon',
'porcupine', 'possum', 'raccoon', 'rat', 'reindeer', 'rhinoceros',
'sandpiper', 'seahorse', 'seal', 'shark', 'sheep', 'snake', 'sparrow',
'squid', 'squirrel', 'starfish', 'swan', 'tiger', 'turkey', 'turtle',
'whale', 'wolf', 'wombat', 'woodpecker', 'zebra']
90
```

```python
class DataModule(pl.LightningDataModule):

    def __init__(self, transform=transform, batch_size=32):
        super().__init__()
        self.root_dir = "/kaggle/input/animal-image-dataset-90-different-animals/animals/animals"
        self.transform = transform
        self.batch_size = batch_size

    def setup(self, stage=None):
        dataset = datasets.ImageFolder(root=self.root_dir, transform=self.transform)
        n_data = len(dataset)
        n_train = int(0.8 * n_data)
        n_test = n_data - n_train

        train_dataset, test_dataset = torch.utils.data.random_split(dataset, [n_train, n_test])

        self.train_dataset = DataLoader(train_dataset, batch_size=self.batch_size, shuffle=True)
        self.test_dataset = DataLoader(test_dataset, batch_size=self.batch_size)

    def train_dataloader(self):
        return self.train_dataset

    def test_dataloader(self):
        return self.test_dataset


class ConvolutionalNetwork(LightningModule):

    def __init__(self):
        super(ConvolutionalNetwork, self).__init__()
        self.conv1 = nn.Conv2d(3, 6, 3, 1)
        self.conv2 = nn.Conv2d(6, 16, 3, 1)
        self.fc1 = nn.Linear(16 * 54 * 54, 120)
        self.fc2 = nn.Linear(120, 84)
        self.fc3 = nn.Linear(84, 20)
        self.fc4 = nn.Linear(20, len(class_names))

    def forward(self, X):
        X = F.relu(self.conv1(X))
        X = F.max_pool2d(X, 2, 2)
        X = F.relu(self.conv2(X))
        X = F.max_pool2d(X, 2, 2)
        X = X.view(-1, 16 * 54 * 54)
        X = F.relu(self.fc1(X))
        X = F.relu(self.fc2(X))
        X = F.relu(self.fc3(X))
        X = self.fc4(X)
        return F.log_softmax(X, dim=1)

    def configure_optimizers(self):
        optimizer = torch.optim.Adam(self.parameters(), lr=0.001)
        return optimizer

    def training_step(self, train_batch, batch_idx):
        X, y = train_batch
        y_hat = self(X)
        loss = F.cross_entropy(y_hat, y)
        pred = y_hat.argmax(dim=1, keepdim=True)
        acc = pred.eq(y.view_as(pred)).sum().item() / y.shape[0]
        self.log("train_loss", loss)
        self.log("train_acc", acc)
        return loss

    def validation_step(self, val_batch, batch_idx):
        X, y = val_batch
        y_hat = self(X)
        loss = F.cross_entropy(y_hat, y)
        pred = y_hat.argmax(dim=1, keepdim=True)
        acc = pred.eq(y.view_as(pred)).sum().item() / y.shape[0]
        self.log("val_loss", loss)
        self.log("val_acc", acc)

    def test_step(self, test_batch, batch_idx):
        X, y = test_batch
        y_hat = self(X)
        loss = F.cross_entropy(y_hat, y)
        pred = y_hat.argmax(dim=1, keepdim=True)
        acc = pred.eq(y.view_as(pred)).sum().item() / y.shape[0]
        self.log("test_loss", loss)
        self.log("test_acc", acc)

datamodule = DataModule()
datamodule.setup()
```

```
train_loader = datamodule.train_dataloader()
for imgs,labels in train_loader:
    break
print(labels)
```

```
if __name__ == '__main__':
    datamodule = DataModule()
    datamodule.setup()
    model = ConvolutionalNetwork()
    trainer = pl.Trainer(max_epochs=20)
    trainer.fit(model, datamodule)
    datamodule.setup(stage='test')
    test_loader = datamodule.test_dataloader()
    trainer.test(dataloaders=test_loader)
```

```
/opt/conda/lib/python3.7/site-packages/pytorch_lightning/trainer/
configuration_validator.py:110: PossibleUserWarning: You defined a
`validation_step` but have no `val_dataloader`. Skipping val loop.
  category=PossibleUserWarning,
/opt/conda/lib/python3.7/site-packages/pytorch_lightning/trainer/conne
ctors/data_connector.py:229: PossibleUserWarning: The dataloader,
train_dataloader, does not have many workers which may be a
bottleneck. Consider increasing the value of the `num_workers`
argument` (try 4 which is the number of cpus on this machine) in the
`DataLoader` init to improve performance.
  category=PossibleUserWarning,
```

```
{"model_id":"cd43b5fb9b3d4233bcf0e3e4a953b885","version_major":2,"vers
ion_minor":0}
```

```
/opt/conda/lib/python3.7/site-packages/pytorch_lightning/trainer/
connectors/checkpoint_connector.py:128: UserWarning:
`.test(ckpt_path=None)` was called without a model. The best model of
the previous `fit` call will be used. You can pass
`.test(ckpt_path='best')` to use the best model or
`.test(ckpt_path='last')` to use the last model. If you pass a value,
this warning will be silenced.
  + f" You can pass `.{fn}(ckpt_path='best')` to use the best model
or"
/opt/conda/lib/python3.7/site-packages/pytorch_lightning/trainer/conne
ctors/data_connector.py:229: PossibleUserWarning: The dataloader,
test_dataloader 0, does not have many workers which may be a
bottleneck. Consider increasing the value of the `num_workers`
argument` (try 4 which is the number of cpus on this machine) in the
`DataLoader` init to improve performance.
  category=PossibleUserWarning,
```

```
{"model_id":"efb9434563fa4a91bae193b3f375cf55","version_major":2,"vers
ion_minor":0}
```

```
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┃        Test metric        ┃       DataLoader 0        ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━┩
│         test_acc          │    0.5425925850868225     │
│         test_loss         │    2.0664007663726807     │
└───────────────────────────┴───────────────────────────┘
```
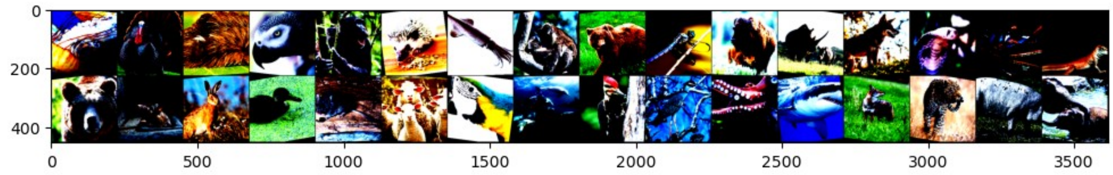
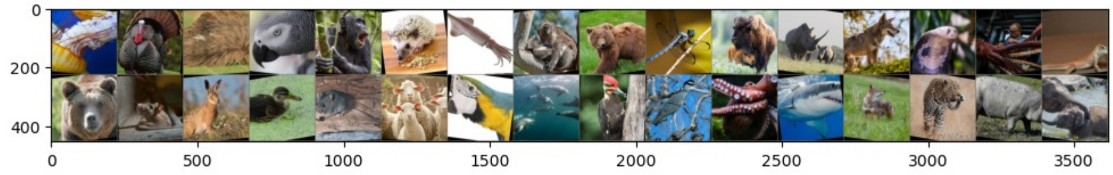

```python
for images, labels in datamodule.train_dataloader():
    break
im=make_grid(images,nrow=16)

plt.figure(figsize=(12,12))
plt.imshow(np.transpose(im.numpy(),(1,2,0)))

inv_normalize=transforms.Normalize(mean=[-0.485/0.229,-0.456/0.224,-0.406/0.225],
                                   std=[1/0.229,1/0.224,1/0.225])
im=inv_normalize(im)

plt.figure(figsize=(12,12))
plt.imshow(np.transpose(im.numpy(),(1,2,0)))
```

```
<matplotlib.image.AxesImage at 0x71341b417390>
```





```python
device = torch.device("cpu")   #"cuda:0"

model.eval()
y_true=[]
y_pred=[]
with torch.no_grad():
    for test_data in datamodule.test_dataloader():
        test_images, test_labels = test_data[0].to(device), test_data[1].to(device)
        pred = model(test_images).argmax(dim=1)
        for i in range(len(pred)):
            y_true.append(test_labels[i].item())
            y_pred.append(pred[i].item())
```

```
print(classification_report(y_true,y_pred,target_names=class_names,dig
its=4))
```

```
                precision    recall  f1-score   support

      antelope     0.4167    0.4167    0.4167        12
        badger     0.5000    0.4545    0.4762        11
           bat     0.2308    0.5455    0.3243        11
          bear     0.3333    0.3636    0.3478        11
           bee     0.6250    0.5000    0.5556        10
        beetle     0.6667    0.3636    0.4706        11
         bison     0.6000    0.6000    0.6000        10
          boar     0.4286    0.2500    0.3158        12
     butterfly     0.5333    0.7273    0.6154        11
           cat     0.3750    0.2000    0.2609        15
   caterpillar     0.8333    0.5882    0.6897        17
    chimpanzee     0.7500    0.7500    0.7500        12
     cockroach     0.7222    1.0000    0.8387        13
           cow     0.3571    0.4545    0.4000        11
        coyote     0.2857    0.4444    0.3478         9
          crab     0.7222    0.6500    0.6842        20
          crow     0.8125    0.7647    0.7879        17
          deer     0.5385    0.4667    0.5000        15
           dog     0.4000    0.5455    0.4615        11
       dolphin     0.8000    1.0000    0.8889         8
        donkey     0.2857    0.1333    0.1818        15
     dragonfly     0.6667    0.5714    0.6154         7
          duck     0.2000    0.1176    0.1481        17
         eagle     0.6429    0.8182    0.7200        11
      elephant     0.6429    0.6429    0.6429        14
      flamingo     0.7222    0.9286    0.8125        14
           fly     0.8667    0.8667    0.8667        15
           fox     0.2308    0.5000    0.3158         6
          goat     0.3636    0.6667    0.4706        12
      goldfish     0.5455    0.7500    0.6316         8
         goose     0.3333    0.0909    0.1429        11
       gorilla     0.8000    0.6667    0.7273        12
   grasshopper     0.5000    0.3333    0.4000        15
       hamster     0.6667    0.7692    0.7143        13
          hare     0.4444    0.3636    0.4000        11
      hedgehog     0.3846    0.4545    0.4167        11
  hippopotamus     0.5000    0.5556    0.5263         9
      hornbill     0.5556    0.4167    0.4762        12
         horse     0.6429    0.6429    0.6429        14
   hummingbird     0.5333    0.7273    0.6154        11
         hyena     0.2857    0.3333    0.3077         6
     jellyfish     0.7000    0.7778    0.7368         9
      kangaroo     0.0000    0.0000    0.0000        15
         koala     0.3846    0.4167    0.4000        12
      ladybugs     0.5556    0.9091    0.6897        11
```

```
       leopard     0.7143    0.3846    0.5000        13
          lion     0.3810    0.5714    0.4571        14
        lizard     1.0000    0.2500    0.4000        16
       lobster     0.5000    0.7500    0.6000         8
      mosquito     0.8182    0.8182    0.8182        11
          moth     0.5455    0.5455    0.5455        11
         mouse     0.2500    0.6000    0.3529         5
       octopus     0.2500    0.2500    0.2500         8
         okapi     0.6923    0.7500    0.7200        12
     orangutan     0.6000    0.8182    0.6923        11
         otter     0.3158    0.5000    0.3871        12
           owl     0.5833    0.6364    0.6087        11
            ox     0.8333    0.2778    0.4167        18
        oyster     0.5000    0.7273    0.5926        11
         panda     0.3684    0.7778    0.5000         9
        parrot     0.6111    0.7333    0.6667        15
pelecaniformes     0.3750    0.4000    0.3871        15
       penguin     0.7000    0.7000    0.7000        10
           pig     0.6250    0.6250    0.6250        16
        pigeon     0.5000    0.3636    0.4211        11
     porcupine     0.6667    1.0000    0.8000         8
        possum     0.4444    0.3333    0.3810        12
       raccoon     0.6250    0.3333    0.4348        15
           rat     0.6154    0.8000    0.6957        10
      reindeer     0.5000    0.4667    0.4828        15
    rhinoceros     0.2727    0.4286    0.3333         7
     sandpiper     0.7647    0.7647    0.7647        17
      seahorse     0.5714    0.5333    0.5517        15
          seal     0.5000    0.6154    0.5517        13
         shark     0.6429    0.7500    0.6923        12
         sheep     0.5556    0.2941    0.3846        17
         snake     0.5714    0.3636    0.4444        11
       sparrow     0.3333    0.2857    0.3077         7
         squid     0.7500    0.5000    0.6000        18
      squirrel     0.2857    0.2857    0.2857        14
      starfish     0.7143    0.3333    0.4545        15
          swan     0.5625    0.7500    0.6429        12
         tiger     0.6667    0.4444    0.5333         9
        turkey     0.5833    0.7778    0.6667         9
        turtle     0.5000    0.6364    0.5600        11
         whale     1.0000    0.4286    0.6000        14
          wolf     0.4375    0.7778    0.5600         9
        wombat     0.6000    0.5455    0.5714        11
    woodpecker     0.5455    0.4286    0.4800        14
         zebra     0.9000    0.9000    0.9000        10

      accuracy                         0.5417      1080
     macro avg     0.5462    0.5533    0.5295      1080
  weighted avg     0.5607    0.5417    0.5300      1080
```

```
/opt/conda/lib/python3.7/site-packages/sklearn/metrics/
_classification.py:1318: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/opt/conda/lib/python3.7/site-packages/sklearn/metrics/_classification
.py:1318: UndefinedMetricWarning: Precision and F-score are ill-
defined and being set to 0.0 in labels with no predicted samples. Use
`zero_division` parameter to control this behavior.
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/opt/conda/lib/python3.7/site-packages/sklearn/metrics/_classification
.py:1318: UndefinedMetricWarning: Precision and F-score are ill-
defined and being set to 0.0 in labels with no predicted samples. Use
`zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```