tensorflow2.0-cnn-project

February 11, 2022

1 boostcourse_tensorflow2.0_cnn_project

1.0.1

- Python 3.6, TensorFlow 2.0   .   .
-                          .   Colab   .

1.1 Colab

.   .

Colab   !

-        :   , `Ctrl + /`   .

```
[48]: # from google.colab import auth
      # auth.authenticate_user()

      # from google.colab import drive
      # drive.mount('/content/drive', force_remount=False)
```

Colab   **folder**   !   , `02_cnn_tf`   "   > colab_notebook
> tensorflow"   , "colab_notebook/tensorflow"   .

`folder` = `"colab_notebook/tensorflow"`

```
[49]: # import os
      # from pathlib import Path

      # # folder                          !
      # # My Drive                    .
      # folder = ""
      # project_dir = "02_cnn_tf"

      # base_path = Path("/content/drive/My Drive/")
      # project_path = base_path / folder / project_dir
      # os.chdir(project_path)
      # for x in list(project_path.glob("*")):
      #     if x.is_dir():
      #         dir_name = str(x.relative_to(project_path))
      #         os.rename(dir_name, dir_name.split(" ", 1)[0])
```

```
# print(f"        : {os.getcwd()}")
```

2 Convolutional Neural Network: Cat-Dog Classifier

- : ImageNet Classification with Deep Convolutional Neural Networks(A Krizhevsky, 2012)

ImageNet classifcation challenge   1000   .   100   .
            ,   (visual recognition)   .   2012 CNN   .

<2012 AlexNet   CNN   >

- :

2011   (error rate) 26%   , 2012 CNN   AlexNet 1   10%   . 2015
CNN   ResNet   3.6%   ,   5%   .   .
CNN   .   CNN   (computer vision)   .
CNN   .   ,   .

            . - CNN   . -   (data augmentation)   . -   . -
      (transfer learning)   .

                                .

<CNN   >
"[**TODO**]   ”   “#   ”   “#   ”   .   **!**
        TensorFlow   **TensorFlow API**   . **API**
        .   . -   . -   (transfer learning)   .

Colab

Convolutional Neural Network: Cat-Dog Classifier

1. Package load

2.   , ,

3.

4. tf.data.Dataset   Input pipeline

5.

6. Loss function   Optimizer

7. Training

8.   Evaluation

9. Transfer Learning

10. Summary

Self-Review

2.1 1. Package load

.

```
from __future__ import absolute_import
from __future__ import division
from __future__ import print_function
from __future__ import unicode_literals

import check_util.checker as checker
from IPython.display import clear_output
from PIL import Image

import os
import time
import re
from glob import glob
import shutil
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

import tensorflow as tf
from tensorflow.keras import layers

print('tensorflow version: {}'.format(tf.__version__))
print('GPU      : {}'.format(tf.test.is_gpu_available()))
```

```
tensorflow version: 2.0.0
GPU      : False
```

2.2 2.   , ,

.   2013   ' '   .   CNN
      95%   .

         -                  .   .

               ,   . (, **Colab**)

```
# import zipfile
# from pathlib import Path

# current_path = Path().absolute()
# data_path = current_path / "data"
# print("       : {}".format(current_path))
# if (data_path / "my_cat_dog").exists():
#     print("  'data/my_cat_dog'              .      !")
# else:
#     with zipfile.ZipFile(str(data_path / "my_cat_dog.zip"), "r") as zip_ref:
```

3

```
#           zip_ref.extractall(str(data_path / "my_cat_dog"))
#       print("Done!")
```

12500   25000   .   .

        .   .

        ,   class 1000 ,   class 500 ,   class 1000   .

```
[52]: data_dir = './data/my_cat_dog'  #
```

                .

                .

            ./data/my_cat_dog.zip   'data'   .

            : 1000
            : 1000
            : 500
            : 500
             : 1000
             : 1000

```
[53]: checker.dataset_check(data_dir)
```

            : 1000
            : 1000
            : 500
            : 500
             : 1000
             : 1000

    dataset   !   .

2.3   3.

                .   (learning rate),   .

        (batch_size),   epoch (max_epochs), (learning_rate)   .

```
[54]: print_steps = 1
val_epoch = 1

batch_size = 20
max_epochs = 20
learning_rate = 1e-4
IMG_SIZE = 150


PATH = data_dir
```

2.4   4. tf.data.Dataset   Input pipeline

- tf.data.Dataset   Importing Data

- tf.keras.datasets   FashionMNIST dataset   .
- tf.data.Dataset   augmentation   .
  - tf.data.Dataset.list_files   tf.data.Dataset   .
  - tf.data.Dataset.map   data augmentation   .

2.4.1   (Data Augmentation)

.   .   (data augmentation)
            .   .   epoch
  .   .

          .

<   >

        .   .

            (data augmentation)   . * random_crop:
          . 150×150 . * random_rotation: random   (-0.3radian ~
0.3radian)   . * flip_left_right: 1/2   .

              ,   .   resize 150×150 .

            .

2.4.2 [TODO]

Augmentation   . TensorFlow   image   API tf.image   .
        API tf.keras.preprocessing.image.ImageDataGenerator   .

load

- tf.io.read_file(filename)   filename   .
  - filename string   .
- tf.io.read_file()   tf.image.decode_jpeg()   decode   tf.uint8
            .
-    tf.cast   tf.uint8   tf.float32   .

```
[55]: def load(image_file, label):
          #          float          .
          image = tf.io.read_file(image_file)
          image = tf.image.decode_jpeg(image)
          image = tf.cast(image, tf.float32)

          return image, label
```

              .

```
[56]: image, label = load(os.path.join(PATH, 'train/cat/cat.100.jpg'), 0)
      # casting to int for matplotlib to show the image
      plt.figure()
      plt.title(label)
```

```
plt.imshow(image/255.0)
plt.show()
```


resize

-     (height width)   .
- argument image resize   height, width   resize   .
- `tf.image.resize`   .

resize   **!** "##   ##" "##   ##"   **None**   .

```
[57]: def resize(input_image, height, width):
          #    height width    resize    .

          ##       ##
          input_image = tf.image.resize(input_image, size = [height, width])
          ##       ##

          return input_image
```

```
[58]: plt.figure()
      plt.subplot(121)
      plt.title("Resized Image")
      plt.imshow(resize(image, 300, 300)/255.0)
      plt.subplot(122)
```

```
plt.title("Original Image")
plt.imshow(image/255.0)
plt.show()
```
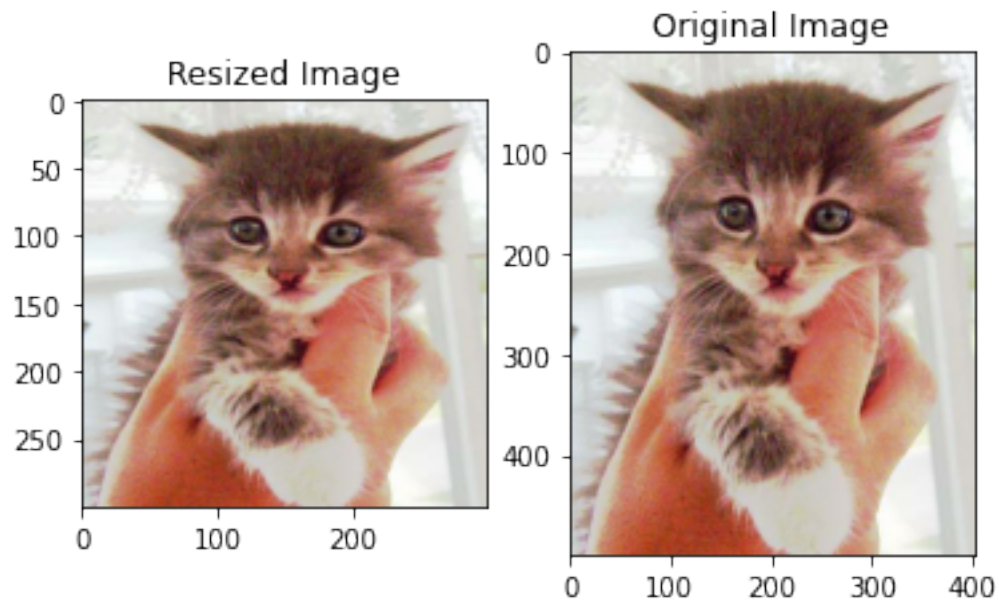


```
[59]: checker.resize_fn_check(resize)
```

resize   !   .

random_rotation

- (random)   .
- Random   angle   np.random.randint   0~3   .
  - tf.image.rot90   .

random_rotation   ! "##   ##" "##   ##"   **None**   .

```
[60]: def random_rotation(input_image):
          #          (radian)          .
          ##     ##
          angles = np.random.randint(3)
          rotated_image = tf.image.rot90(input_image,angles)
          ##     ##

          return rotated_image
```

```
[61]: plt.figure()
      plt.subplot(121)
      plt.title("Rotate Image")
```

```
plt.imshow(random_rotation(image)/255.0)
plt.subplot(122)
plt.title("Original Image")
plt.imshow(image/255.0)
plt.show()
```
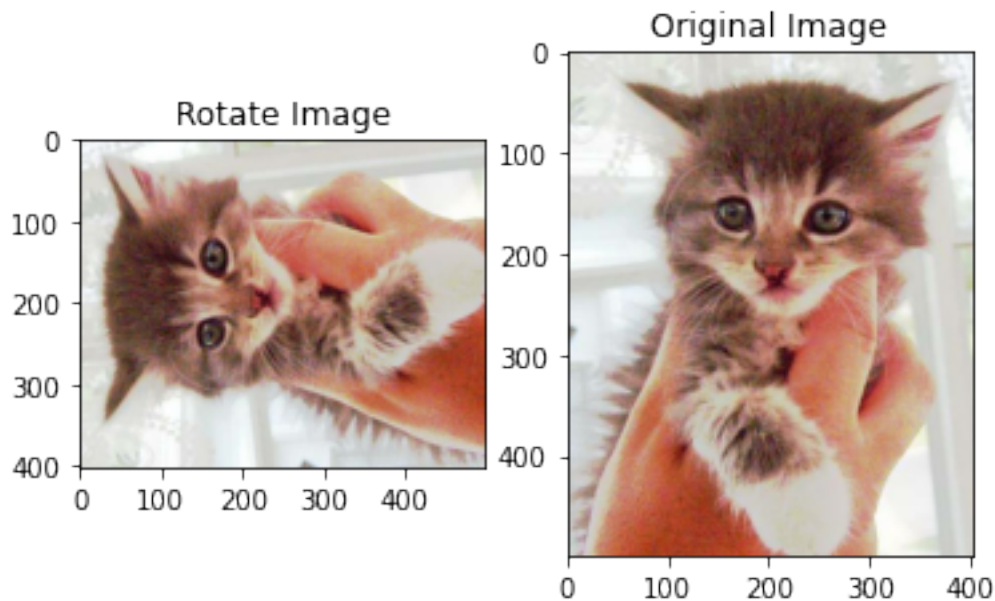

random_crop

- size crop ( ) .
    - crop random `random_crop` .
    - `central_crop` .
- `tf.image.random_crop`
    - tf.image.random_crop(image, size) (argument) crop size(, ,) .

random_crop ! "## ##" "## ##" **None** .

```
[62]: def random_crop(input_image):

    ##    ##
    cropped_image = tf.image.random_crop(input_image, size = [IMG_SIZE,␣
    ↪IMG_SIZE, 3])
    ##    ##

    return cropped_image
```

```
[63]: plt.figure()
plt.subplot(121)
```

```
plt.title("Cropped Image")
plt.imshow(random_crop(image)/255.0)
plt.subplot(122)
plt.title("Original Image")
plt.imshow(image/255.0)
plt.show()
```
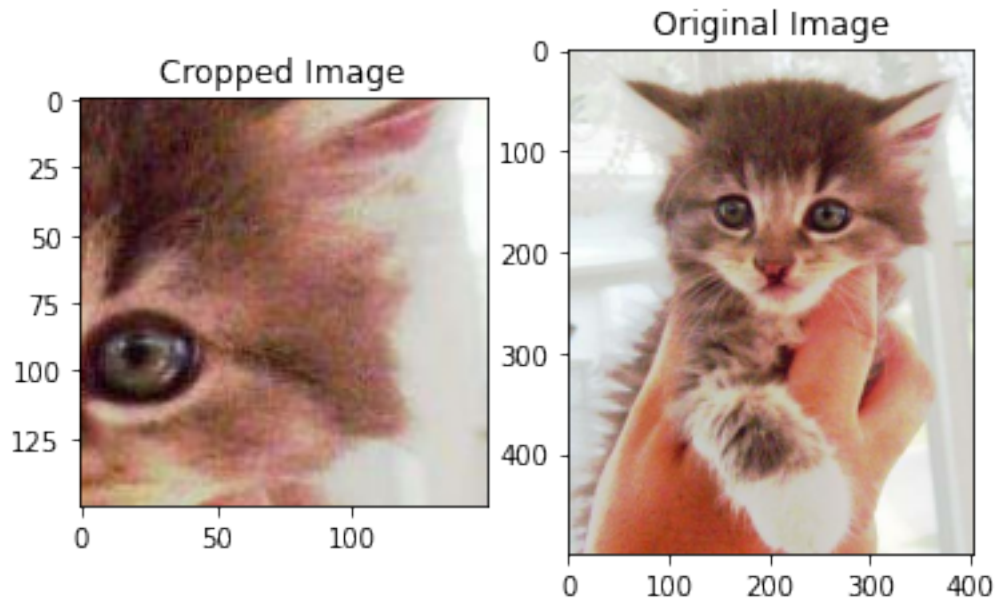

[64]: `checker.random_crop_fn_check(random_crop)`

random_crop   !   .

normalize

- [0, 255]   .
- [0, 255]   [-1, 1]   normalize   .
-        normalize   .   (TensorFlow   ).
    –   127.5   : [0, 255] -> [0, 2]
    –   1   : [0, 2] -> [-1, 1]

normalize   ! "##   ##" "##   ##"   None   .

[65]:
```
# normalizing the images to [-1, 1]
def normalize(input_image):
    #           normalize   . [0, 255] -> [-1, 1]

    #
    input_image = input_image/127.5 - 1
    #
```

9

```
    return input_image
```

[66]:
```
checker.normalize_fn_check(normalize)
```

normalize   !   .

random_jitter

- random_jitter   (augment)   resize, random_rotation, random_crop
  .
- random_jitter   random   .
  - tf.image.random_flip_left_right
-      pipeline
  1. resize: 176 x 176 size resize
  2. random_crop: 150 x 150 size random crop
  3. random_rotation: (random_rotation   )
  4. random_flip_left_right:

random_jitter   ! "##   ##" "##   ##"   **None**   .

[68]:
```python
def random_jitter(input_image):
    # resize, random_crop, random_rotation, random_flip        augmentation    .

    ##      ##
    # resizing to 176 x 176 x 3
    input_image = resize(input_image, 176, 176)
    # randomly cropping to 150 x 150 x 3
    input_image = random_crop(input_image)
    # randomly rotation
    input_image = random_rotation(input_image)
    # randomly mirroring
    input_image = tf.image.random_flip_left_right(input_image)
    ##      ##

    return input_image
```

[69]:
```python
plt.figure()
plt.subplot(121)
plt.title("jitter Image")
plt.imshow(random_jitter(image)/255.0)
plt.subplot(122)
plt.title("Original Image")
plt.imshow(image/255.0)
plt.show()
```
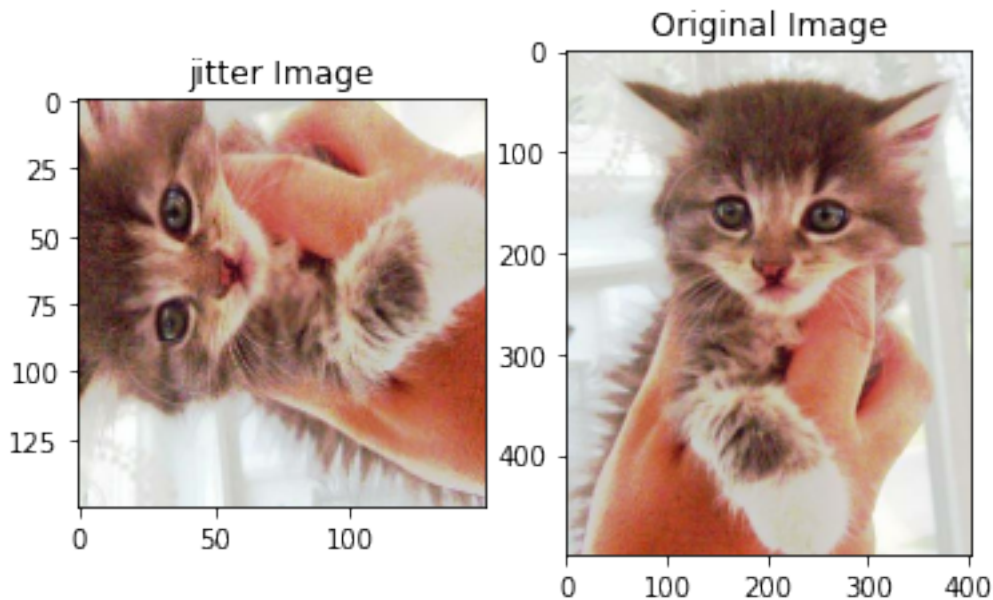
central_crop

- random_jitter .
- (validation) .
- . central_crop .
  - tf.image.central_crop
  - central_crop (crop) central_fraction .
  - (176 x 176) resize central_fraction (150 x 150) crop .
  - . " = (crop) / " .

central_crop ! "## ##" "## ##" None .

```
[70]: def central_crop(input_image):
          # 176 x 176    resize   150 x 150    crop   .

          ##      ##
          # resizing to 176 x 176 x 3
          input_image = resize(input_image, 176, 176,)
          # central cropping to 150 x 150 x 3
          input_image = tf.image.central_crop(input_image,0.85)
          ##      ##

          return input_image
```

```
[29]: plt.figure()
      plt.subplot(121)
      plt.title("Central Cropped Image")
```

```
plt.imshow(central_crop(image)/255.0)
plt.subplot(122)
plt.title("Original Image")
plt.imshow(image/255.0)
plt.show()
```

Central Cropped Image

Original Image
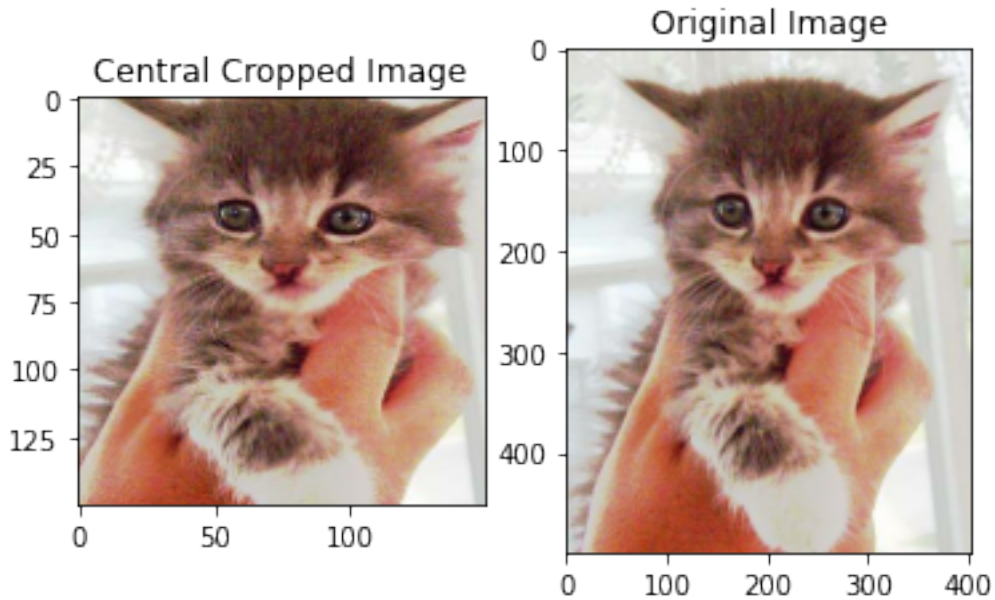
[30]: `checker.central_crop_fn_check(central_crop)`

central_crop   !   .

load_image_train

-       load pipeline   .   3   .
- load -> random_jitter -> normalize
    1. image load
    2. random_jitter
    3.   normalization

load_image_train   ! "##   ##" "##   ##"   **None**   .

[71]:
```python
def load_image_train(image_file, label):

    ##          ##
    input_image, label = load(image_file, label)
    input_image = random_jitter(input_image)
    input_image = normalize(input_image)
    ##          ##
```

```
        return input_image, label
```

load_image_val_and_test

- (validation)   load pipeline   .   3   .
- `load` -> `central_crop` -> `normalize`
    1. image load
    2.   `central_crop`   .
    3. input   normalize

load_image__val_and_test   **!** "##   ##" "##   ##"   **None**   .

```python
[72]: def load_image_val_and_test(image_file, label):

          ##      ##
          input_image, label = load(image_file, label)
          input_image = central_crop(input_image)
          input_image = normalize(input_image)
          ##      ##

          return input_image, label
```

2.4.3 Input pipeline

- augmentation   input data pipeline   .

```python
[73]: def add_label(image_file, label):
          return image_file, label
```

```python
[74]: # train folder          list      .
      #          category      list        .
      folder_list = [f for f in os.listdir(os.path.join(PATH, 'train')) if not f.
       ↪startswith('.')]
```

1. `tf.data.Dataset.list_files`   ('cat')   `*.jpg`   `train_dataset`   .
2.   dataset `tf.data.Dataset.map`   label(0)   .
3. for   `folder_list`   .
4. `tf.data.Dataset.list_files`   ('dog')   `*.jpg`   `temp_dataset`   .
5.   dataset `tf.data.Dataset.map`   label(1)   .
6. `train_dataset`('cat'   ) `temp_dataset`('dog'   ) `tf.data.Dataset.concatenate`   .
7. for   . (label   `train_dataset`   .

```python
[75]: train_dataset = tf.data.Dataset.list_files(                          # 1
          os.path.join(PATH, 'train', folder_list[0], '*.jpg'))
      train_dataset = train_dataset.map(lambda x: add_label(x, 0))         # 2
      for label, category_name in enumerate(folder_list[1:], 1):           # 3
          temp_dataset = tf.data.Dataset.list_files(                       # 4
              os.path.join(PATH, 'train', category_name, '*.jpg'))
          temp_dataset = temp_dataset.map(lambda x: add_label(x, label))   # 5
```

```
    train_dataset = train_dataset.concatenate(temp_dataset)        # 6
```

WARNING:tensorflow:Entity <function <lambda> at 0x0000024787B25AF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function <lambda> at 0x0000024787B25AF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x0000024787B25AF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'
WARNING:tensorflow:Entity <function <lambda> at 0x00000247873AAAF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function <lambda> at 0x00000247873AAAF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x00000247873AAAF8> could not be
transformed and will be executed as-is. Please report this to the AutoGraph
team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

```
[76]:  N = BUFFER_SIZE = len(list(train_dataset)) # number of samples in train_dataset
       train_dataset = train_dataset.shuffle(BUFFER_SIZE)
       train_dataset = train_dataset.map(load_image_train,
                                         num_parallel_calls=16)
       train_dataset = train_dataset.batch(batch_size)
       train_dataset = train_dataset.repeat()
```

WARNING:tensorflow:Entity <function load_image_train at 0x0000024786506E58>
could not be transformed and will be executed as-is. Please report this to the
AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export
AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named
'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function load_image_train at 0x0000024786506E58>

could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function load_image_train at 0x0000024786506E58> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

```
[77]: folder_list = [f for f in os.listdir(os.path.join(PATH, 'val')) if not f.
      ↪startswith('.')]
      val_dataset = tf.data.Dataset.list_files(os.path.join(PATH, 'val',␣
      ↪folder_list[0], '*.jpg'))
      val_dataset = val_dataset.map(lambda x: add_label(x, 0))
      for label, category_name in enumerate(folder_list[1:], 1):
          temp_dataset = tf.data.Dataset.list_files(os.path.join(PATH, 'val',␣
      ↪category_name, '*.jpg'))
          temp_dataset = temp_dataset.map(lambda x: add_label(x, label))
          val_dataset = val_dataset.concatenate(temp_dataset)

      val_dataset = val_dataset.map(load_image_val_and_test)
      val_dataset = val_dataset.batch(batch_size)
      val_dataset = val_dataset.repeat()
```

WARNING:tensorflow:Entity <function <lambda> at 0x0000024786506828> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function <lambda> at 0x0000024786506828> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x0000024786506828> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
WARNING:tensorflow:Entity <function <lambda> at 0x000002478712E288> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function <lambda> at 0x000002478712E288> could not be

transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x000002478712E288> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function load_image_val_and_test at 0x0000024786506C18> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function load_image_val_and_test at 0x0000024786506C18> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function load_image_val_and_test at 0x0000024786506C18> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

```python
[78]: folder_list = [f for f in os.listdir(os.path.join(PATH, 'test')) if not f.
      ↪startswith('.')]
      test_dataset = tf.data.Dataset.list_files(os.path.join(PATH, 'test',
      ↪folder_list[0], '*.jpg'))
      test_dataset = test_dataset.map(lambda x: add_label(x, 0))
      for label, category_name in enumerate(folder_list[1:], 1):
          temp_dataset = tf.data.Dataset.list_files(os.path.join(PATH, 'test',
      ↪category_name, '*.jpg'))
          temp_dataset = temp_dataset.map(lambda x: add_label(x, label))
          test_dataset = test_dataset.concatenate(temp_dataset)

      test_dataset = test_dataset.map(load_image_val_and_test)
      test_dataset = test_dataset.shuffle(BUFFER_SIZE)
      test_dataset = test_dataset.batch(batch_size)
      test_dataset = test_dataset.repeat()
```

WARNING:tensorflow:Entity <function <lambda> at 0x000002478715DDC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
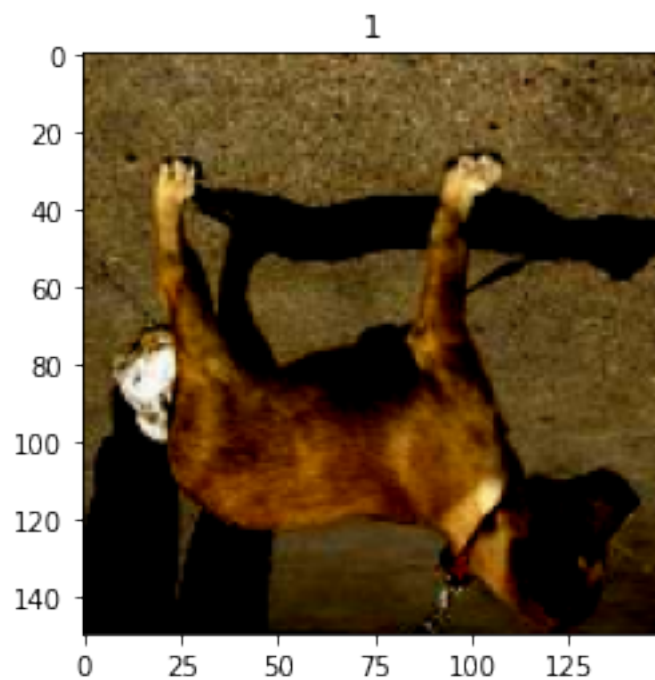
WARNING:tensorflow:Entity <function <lambda> at 0x000002478715DDC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x000002478715DDC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
WARNING:tensorflow:Entity <function <lambda> at 0x0000024787B25DC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function <lambda> at 0x0000024787B25DC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <function <lambda> at 0x0000024787B25DC8> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

.

.

```
[79]: checker.customized_dataset_check(train_dataset)
```

tf.data.Dataset   train_dataset   !   .

2.4.4 Augmented image

.

```
[80]: for images, labels in train_dataset.take(1):
          for j in range(20):
              plt.figure()
              plt.imshow(images[j])
              plt.title(labels[j].numpy())
              plt.show()
```
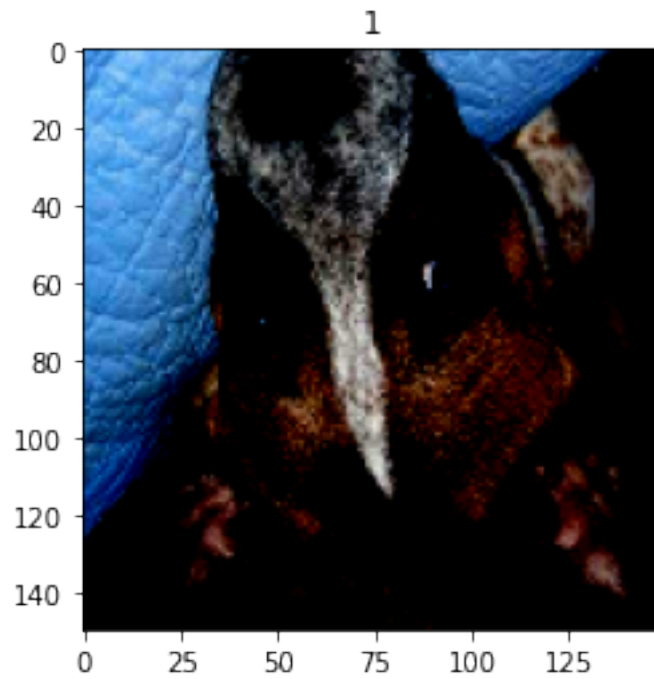
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
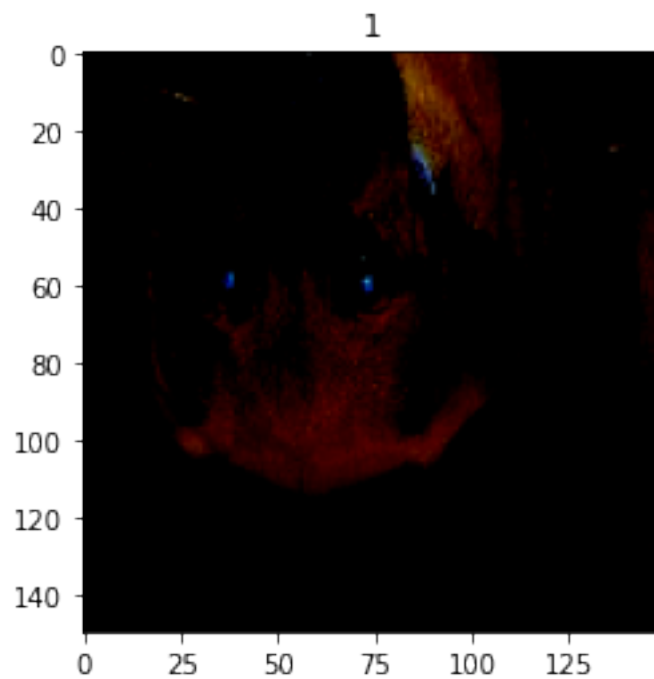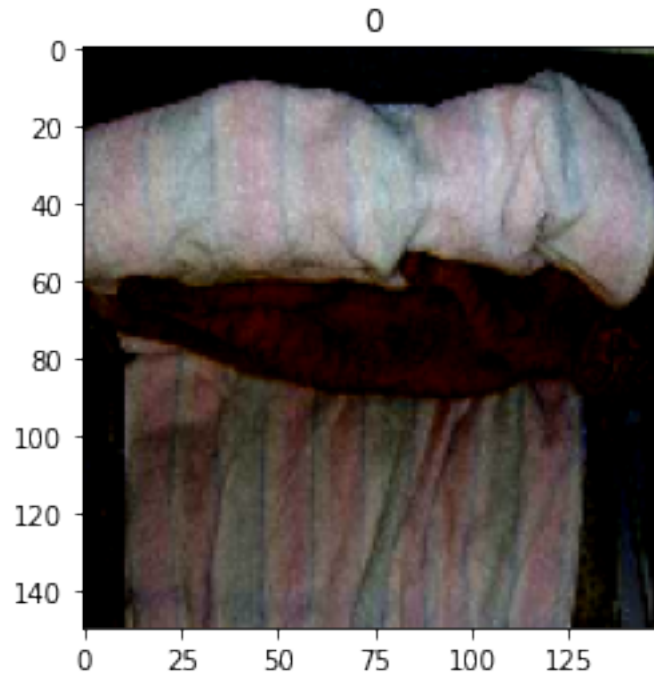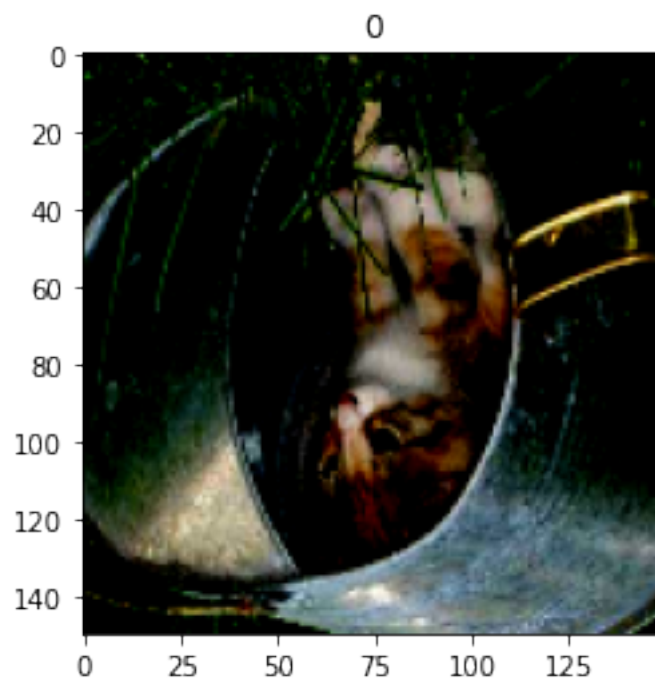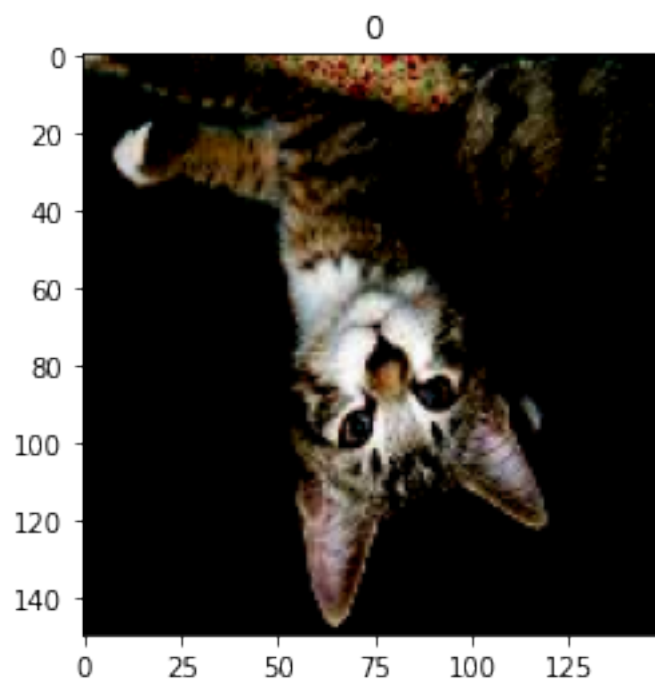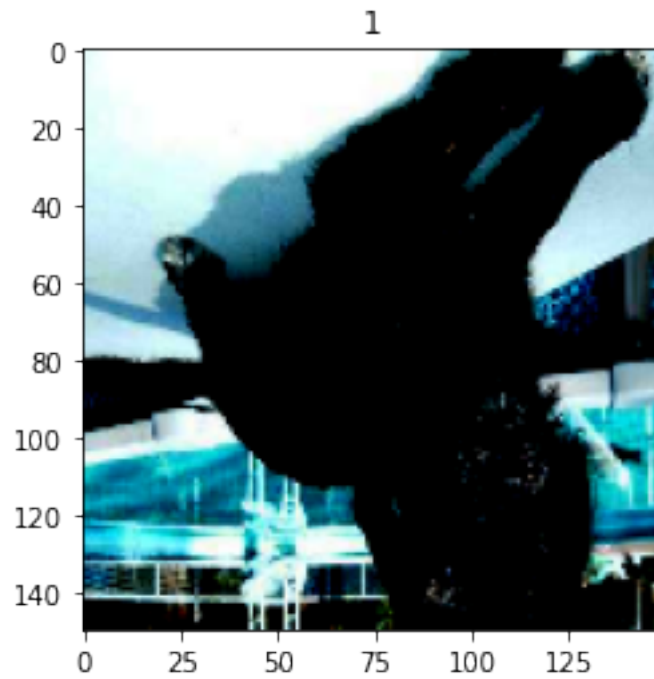
1

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
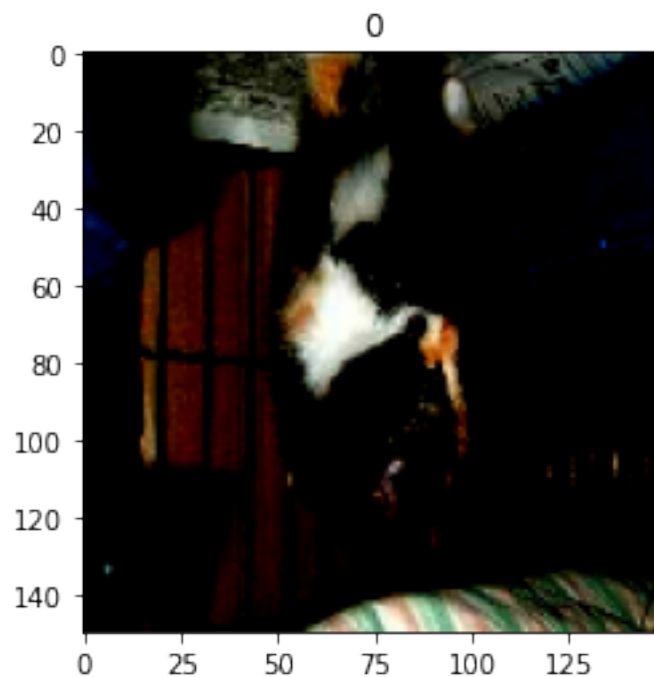

1

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
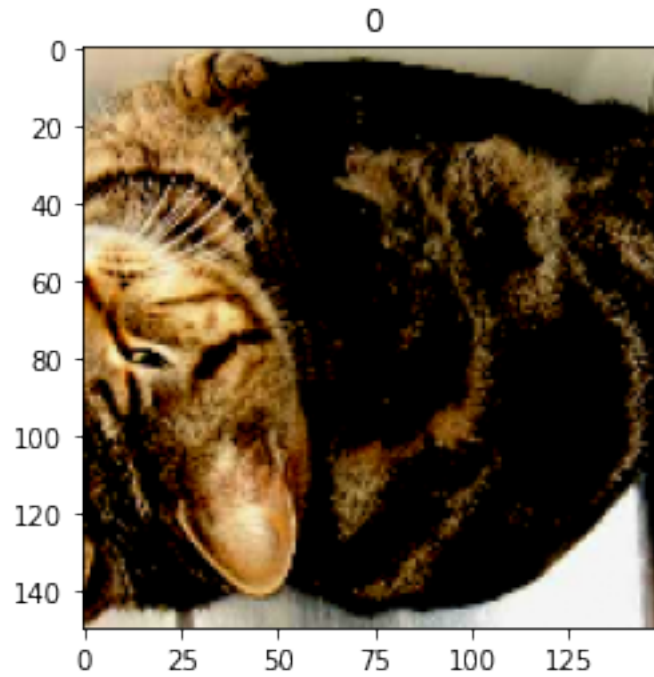RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
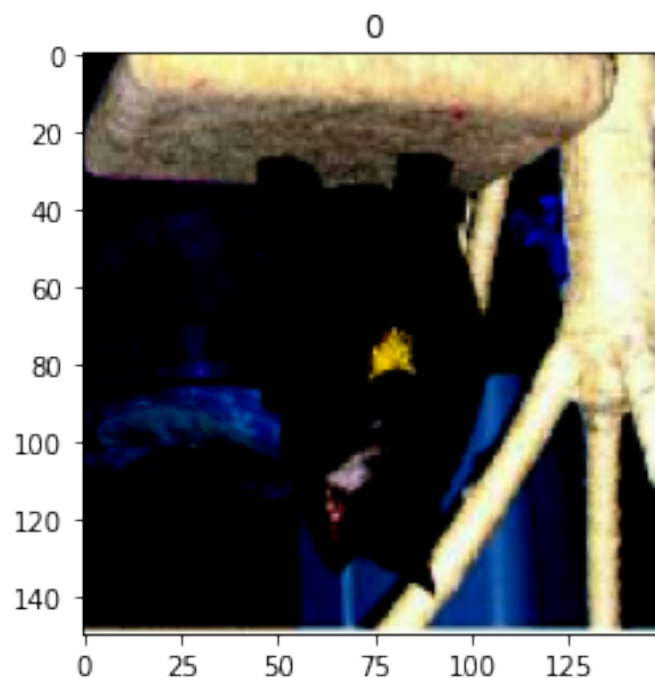RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
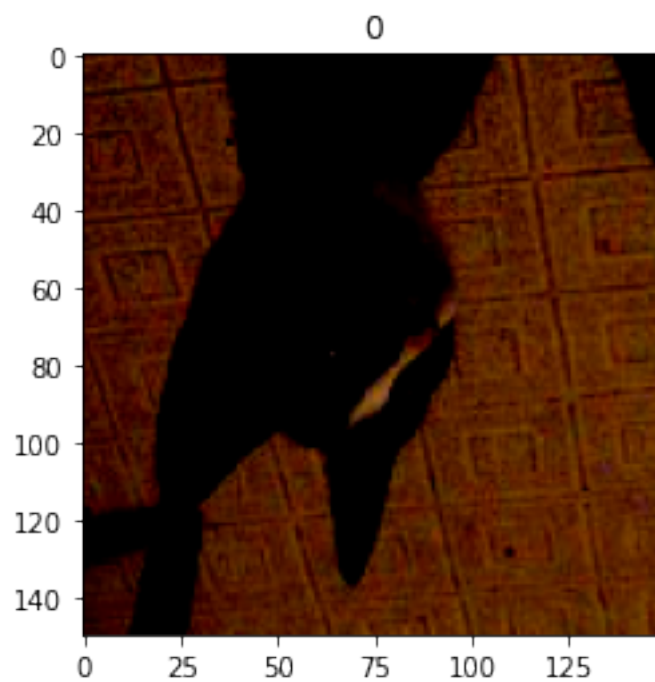
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

0

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
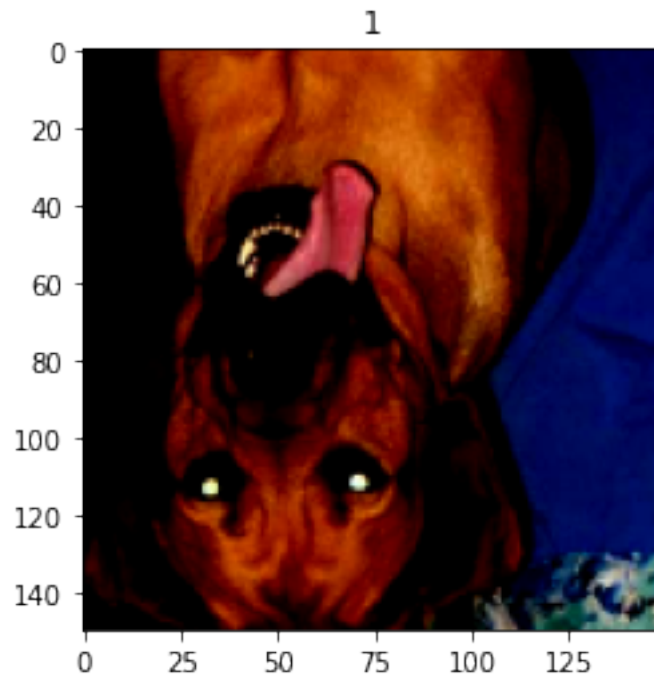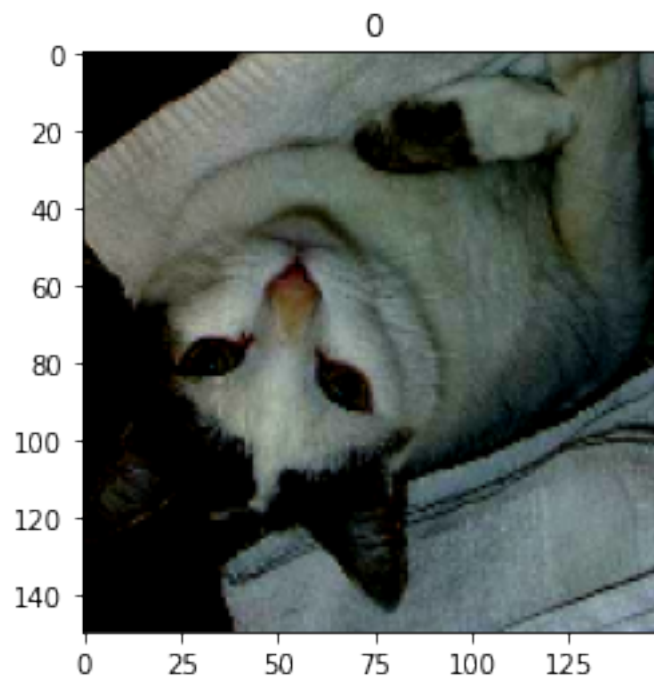RGB data ([0..1] for floats or [0..255] for integers).

0

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).
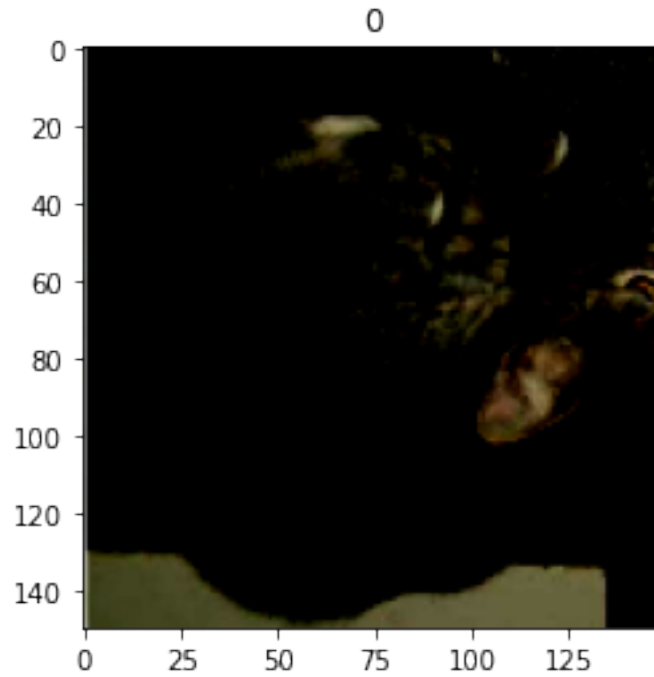

0

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
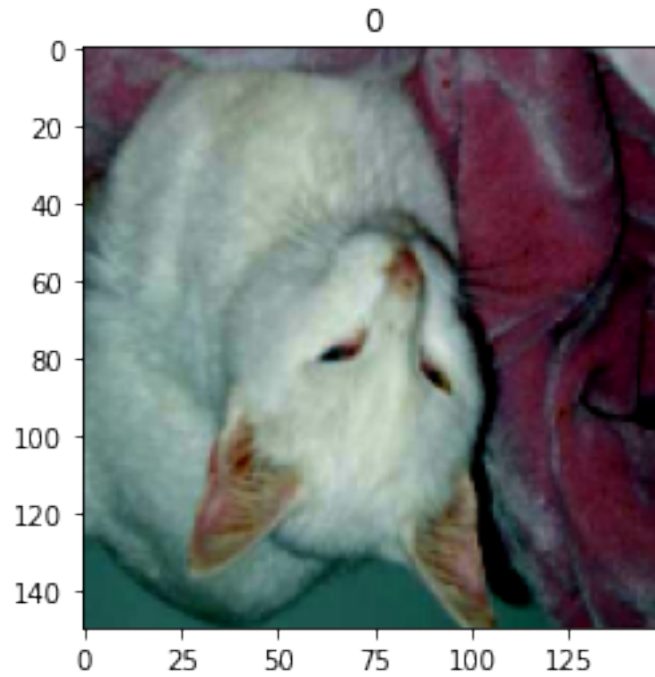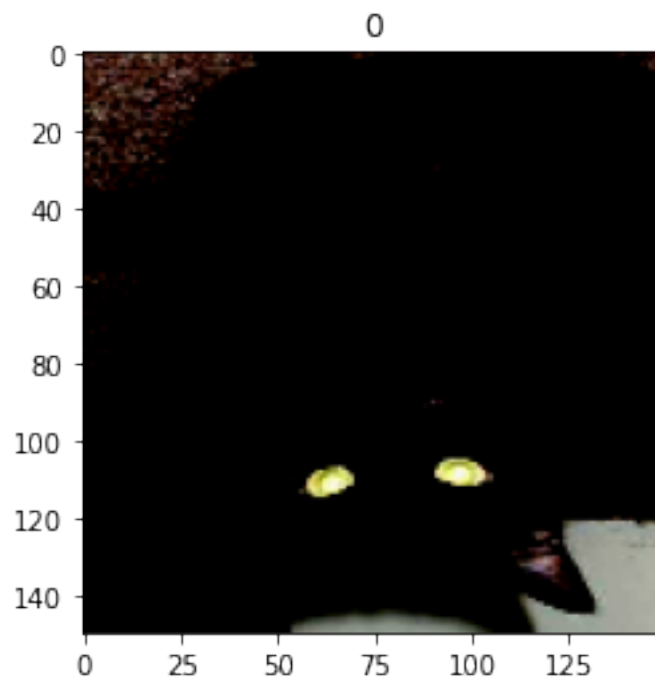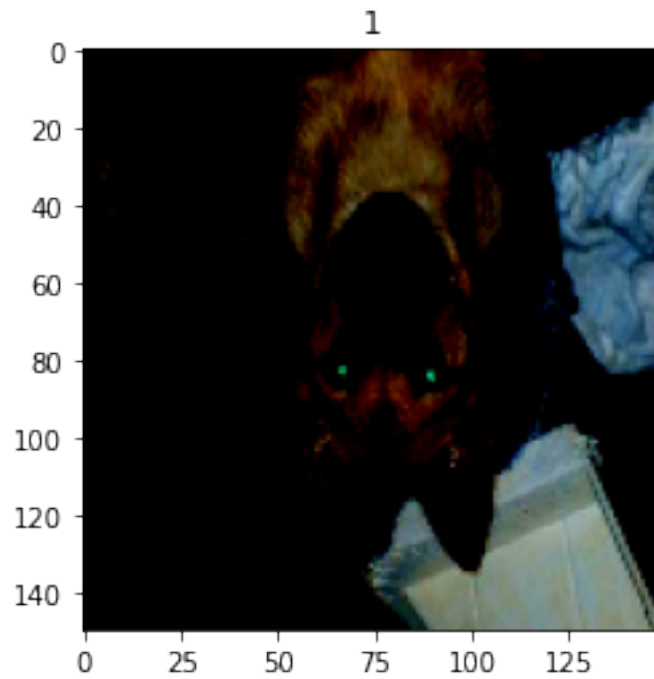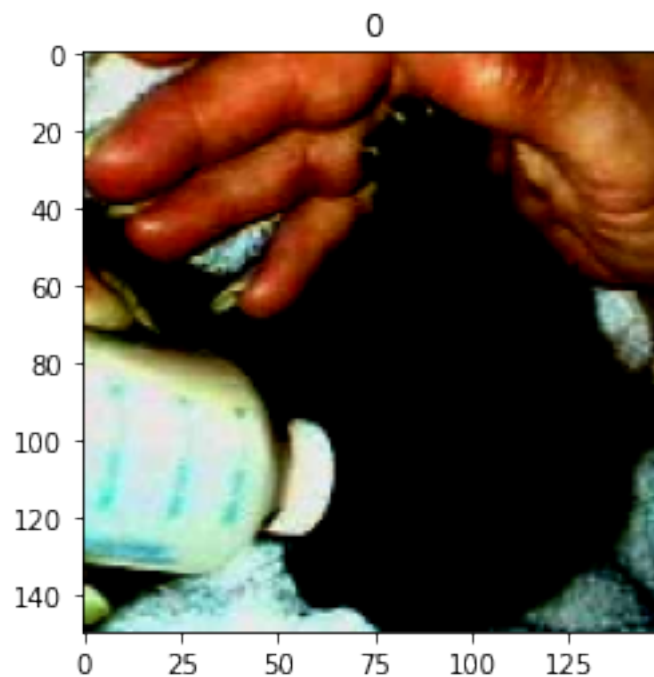
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

WARNING:matplotlib.image:Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).

```
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers).
```


2.5   5.

.   CNN   convolutional layer   ,   dense layer

.

2.5.1   Conv layer(Conv - BatchNorm - ReLU - Pool)

2.5.2   [TODO]

- Convolution   Batch normalization - ReLU - MaxPooling   .   (Conv - BN - ReLU - MaxPooling)   `class`   .
- TensorFlow `tf.keras.layers.Conv2d`   convolutional layer   .   (arguments) (   )   `num_filters`   ( )   `kernel_size`   .
- convolutional layer   batch normalization(`tf.keras.layers.BatchNormalization`) activation function   ReLU(`tf.keras.layers.ReLU`)   .
- ReLU   2x2   maxpooling(`tf.keras.layers.MaxPool2D`)   .   maxpooling `pool_size`   .
-     class `BatchNormalization`   class   `call`   `training`   .
- `class`   .

Conv layer   ! "## ##" "## ##"   **None**   .

29

```
[81]:  class Conv(tf.keras.Model):
           def __init__(self, filters, kernel_size):
               super(Conv, self).__init__()

               ##       ##
               self.conv = tf.keras.layers.Conv2D(filters, kernel_size)
               self.bn = tf.keras.layers.BatchNormalization()
               self.relu = tf.keras.layers.ReLU()
               self.pool = tf.keras.layers.MaxPool2D(pool_size=(2,2))
               ##       ##

           def call(self, inputs, training=True):

               ##       ##
               x = self.conv(inputs)     # self.conv forward
               x = self.bn(x)     # self.bn    forward
               x = self.relu(x)    # self.relu forward
               x = self.pool(x)     # self.pool forward
               ##       ##

               return x
```

Conv class   check   .

2.5.3 [**TODO**]   :

4   Convolutional layer (:Conv)   .   . -   `self.conv`
Conv   . TensorFlow `tf.keras.layers.Conv2d`   convolutional layer   . -   Conv
(kerner_size) 3x3   . -   Conv   3 .   RGB 3   .   .
32   . -   Conv   64   . -   Conv   128   . -   Conv   128   .

,   dense layer   .   . -   2 dense layer   . -   dense layer(`self.dense1`)
     convolution layer   .   convolution layer
5x5x128(height x width x channels)   .   dense layer   512   . -   dense layer(`self.dense2`)
        class   . -   class   *binary classification*   `sigmoid`   .
-     `CategoricalCrossentropy`   `BinaryCrossentropy`   . -   dense layer   ReLU,
   dense layer   Softmax   .

2.5.4   [**Tensorflow 1.x   2.x   **]

- Tensorflow 1.x   2.x   `eager`   `default`   .   tensorflow   session
              . 2.x   eager   default   `keras high-level api`   api   .
-          `tf.keras`   sequential   . sequential   . `layer`   `add`
  model   .   `class`   model   .

      ! "##   ##" "##   ##"   **None**   .

```
[ ]:  model = tf.keras.Sequential()
```

```
##      ##
model.add(Conv(32,3))
model.add(Conv(64,3))
model.add(Conv(128,3))
model.add(Conv(128,3))

model.add(tf.keras.layers.Flatten())  # flatten
model.add(tf.keras.layers.Dense(512, activation ='relu'))  # relu
model.add(tf.Keras.layers.Dense(2, activation='softmax'))

model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate),
              loss = tf.keras.losses.SparseCategoricalCrossentropy(from_logits=␣
  ↪True),
              metrics = ['accuracy'])
##      ##
```

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2905302172.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
AttributeError: module 'tensorflow' has no attribute 'Keras'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records

```
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2905302172.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
AttributeError: module 'tensorflow' has no attribute 'Keras'


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'
```

```
During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2905302172.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
AttributeError: module 'tensorflow' has no attribute 'Keras'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2947, in _run_cell
    return runner(coro)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\async_helpers.py", line 68, in _pseudo_sync_runner
    coro.send(None)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3173, in run_cell_async
    interactivity=interactivity, compiler=compiler, result=result)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3383, in run_ast_nodes
    self.showtraceback()
```

```
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1143, in structured_traceback
    chained_exceptions_tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
```

```
      if getattr(getmodule(object, filename), '__loader__', None) is not None:
    File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
  getmodule
      if ismodule(module) and hasattr(module, '__file__'):
    File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
  packages\tensorflow\__init__.py", line 50, in __getattr__
      module = self._load()
    File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
  packages\tensorflow\__init__.py", line 44, in _load
      module = _importlib.import_module(self.__name__)
    File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
  127, in import_module
      return _bootstrap._gcd_import(name[level:], package, level)
    File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
    File "<frozen importlib._bootstrap>", line 983, in _find_and_load
    File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
  ModuleNotFoundError: No module named 'tensorflow_core.estimator'
```

[82]: ```
model(images[:1])
```

ERROR! Session/line number was not unique in database. History logging moved to
new session 159

[82]: ```
<tf.Tensor: id=14279, shape=(1, 512), dtype=float32, numpy=
array([[9.49911401e-02, 2.45860498e-02, 4.95524518e-02, 1.14866629e-01,
        1.38579667e-01, 0.00000000e+00, 2.80154068e-02, 0.00000000e+00,
        2.49889232e-02, 2.95599494e-02, 4.12392169e-02, 8.20528567e-02,
        0.00000000e+00, 0.00000000e+00, 1.72848195e-01, 5.60318157e-02,
        1.33821024e-02, 9.22949910e-02, 0.00000000e+00, 5.95743433e-02,
        0.00000000e+00, 0.00000000e+00, 6.62169084e-02, 1.22322291e-01,
        0.00000000e+00, 0.00000000e+00, 6.82513863e-02, 0.00000000e+00,
        1.04710340e-01, 0.00000000e+00, 5.99119700e-02, 3.55077609e-02,
        0.00000000e+00, 4.24284413e-02, 4.89465892e-03, 4.79641296e-02,
        1.40454322e-02, 0.00000000e+00, 1.03787612e-02, 0.00000000e+00,
        0.00000000e+00, 0.00000000e+00, 6.73348531e-02, 0.00000000e+00,
        1.40644640e-01, 9.98901427e-02, 0.00000000e+00, 8.98122564e-02,
        0.00000000e+00, 0.00000000e+00, 1.04563013e-02, 2.96383500e-02,
        0.00000000e+00, 0.00000000e+00, 3.29160430e-02, 2.30686516e-02,
        0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 7.31419995e-02,
        0.00000000e+00, 2.67536938e-02, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00, 7.60860369e-02, 0.00000000e+00, 8.70543122e-02,
        1.61569849e-01, 3.53944227e-02, 0.00000000e+00, 0.00000000e+00,
        6.69980748e-03, 0.00000000e+00, 8.75371695e-02, 0.00000000e+00,
        4.65468829e-03, 3.34620941e-03, 5.97108230e-02, 0.00000000e+00,
        1.10915536e-02, 6.04828075e-02, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00, 2.19605360e-02, 1.70748937e-03, 9.50774923e-02,
        1.47419991e-02, 1.97920250e-04, 0.00000000e+00, 3.85198034e-02,
        4.79148142e-03, 2.38263886e-02, 0.00000000e+00, 1.15162844e-03,
```

```
1.14559285e-01, 7.97140077e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 2.81424057e-02, 2.87939124e-02, 6.93603233e-02,
0.00000000e+00, 0.00000000e+00, 1.05714336e-01, 0.00000000e+00,
9.79902968e-02, 9.06284377e-02, 0.00000000e+00, 1.48141636e-02,
8.32389444e-02, 0.00000000e+00, 0.00000000e+00, 7.87797719e-02,
0.00000000e+00, 0.00000000e+00, 2.97878794e-02, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 2.89197639e-02, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
4.12871055e-02, 0.00000000e+00, 0.00000000e+00, 4.27795108e-03,
0.00000000e+00, 7.86075890e-02, 9.37459432e-03, 0.00000000e+00,
6.47827387e-02, 4.91825258e-03, 9.90028530e-02, 5.66134527e-02,
0.00000000e+00, 0.00000000e+00, 2.43929159e-02, 0.00000000e+00,
9.19692218e-02, 0.00000000e+00, 3.26778740e-04, 4.99450900e-02,
3.67696881e-02, 1.16455726e-01, 1.57571933e-03, 1.71212092e-01,
2.41305977e-02, 8.67117941e-02, 0.00000000e+00, 0.00000000e+00,
5.79292979e-03, 0.00000000e+00, 0.00000000e+00, 2.64974055e-03,
0.00000000e+00, 5.00619933e-02, 1.79565683e-01, 0.00000000e+00,
7.50950351e-02, 6.11476637e-02, 1.14002667e-01, 2.73281690e-02,
9.87065062e-02, 0.00000000e+00, 1.47227108e-01, 0.00000000e+00,
7.52196833e-03, 3.51357367e-03, 0.00000000e+00, 3.96595784e-02,
4.94423024e-02, 1.08350478e-01, 0.00000000e+00, 8.21948349e-02,
2.28525363e-02, 0.00000000e+00, 1.81638952e-02, 1.22142605e-01,
0.00000000e+00, 0.00000000e+00, 9.71863270e-02, 7.73082748e-02,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 1.91421434e-02,
0.00000000e+00, 1.38961941e-01, 0.00000000e+00, 0.00000000e+00,
5.29516190e-02, 4.49514650e-02, 0.00000000e+00, 0.00000000e+00,
1.00023717e-01, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 5.62126525e-02, 7.05561414e-02, 4.20805849e-02,
0.00000000e+00, 7.44478852e-02, 9.27958339e-02, 0.00000000e+00,
1.00708023e-01, 0.00000000e+00, 1.07369713e-01, 4.79408465e-02,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 1.42978132e-01,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 3.51053514e-02, 7.70358294e-02, 3.97378542e-02,
2.24242192e-02, 3.17686573e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 1.03415959e-01, 8.61390866e-03, 5.33221252e-02,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
1.78959779e-02, 1.28644630e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 4.39919643e-02,
0.00000000e+00, 0.00000000e+00, 7.68085644e-02, 0.00000000e+00,
0.00000000e+00, 2.45648995e-02, 1.03319727e-01, 4.23144326e-02,
0.00000000e+00, 0.00000000e+00, 7.54077509e-02, 5.97405061e-03,
4.63183187e-02, 3.00785806e-02, 1.14937529e-01, 3.44324671e-02,
0.00000000e+00, 0.00000000e+00, 1.25939520e-02, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 1.09518439e-01, 0.00000000e+00,
1.96084380e-03, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 1.58605903e-01, 0.00000000e+00, 0.00000000e+00,
```

3.25107835e-02, 3.05514969e-02, 0.00000000e+00, 0.00000000e+00,
3.26399207e-02, 1.00195356e-01, 0.00000000e+00, 0.00000000e+00,
7.20179826e-02, 0.00000000e+00, 2.45127194e-02, 2.40576282e-01,
0.00000000e+00, 4.00479510e-03, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 4.06397805e-02, 1.34943157e-01,
5.68528362e-02, 1.36525221e-02, 0.00000000e+00, 3.53528261e-02,
0.00000000e+00, 0.00000000e+00, 5.19536324e-02, 9.28370655e-03,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 7.24729989e-03,
6.68894267e-03, 0.00000000e+00, 2.60430798e-02, 0.00000000e+00,
0.00000000e+00, 3.11074648e-02, 9.89369899e-02, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 6.66721165e-02, 3.33601981e-02,
0.00000000e+00, 6.69562593e-02, 0.00000000e+00, 6.22787438e-02,
0.00000000e+00, 4.49502729e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 6.31812736e-02, 5.34760207e-02, 0.00000000e+00,
1.02702200e-01, 5.86277358e-02, 0.00000000e+00, 0.00000000e+00,
3.93507071e-03, 1.18759431e-01, 0.00000000e+00, 6.15311936e-02,
1.04765989e-01, 5.76014630e-02, 4.81863692e-02, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 3.06449458e-02, 0.00000000e+00,
8.32674578e-02, 0.00000000e+00, 5.05207330e-02, 8.43837559e-02,
1.39035970e-01, 1.20351911e-02, 1.00641958e-01, 1.64160337e-02,
0.00000000e+00, 0.00000000e+00, 4.49763797e-03, 0.00000000e+00,
0.00000000e+00, 1.02477349e-01, 0.00000000e+00, 1.32394463e-01,
0.00000000e+00, 0.00000000e+00, 8.54694694e-02, 4.69799452e-02,
0.00000000e+00, 7.36976713e-02, 2.47506262e-03, 0.00000000e+00,
6.15604110e-02, 0.00000000e+00, 0.00000000e+00, 2.84221023e-02,
0.00000000e+00, 0.00000000e+00, 1.18970893e-01, 0.00000000e+00,
0.00000000e+00, 5.81161343e-02, 0.00000000e+00, 1.26441279e-02,
1.51273450e-02, 1.64293572e-02, 0.00000000e+00, 0.00000000e+00,
2.84561757e-02, 9.70998080e-04, 0.00000000e+00, 1.42773697e-02,
0.00000000e+00, 8.66669565e-02, 1.37031838e-01, 6.39987588e-02,
6.07405007e-02, 7.06433058e-02, 3.34050320e-02, 3.69726010e-02,
6.83329776e-02, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
6.47496199e-04, 0.00000000e+00, 0.00000000e+00, 4.70526516e-02,
5.76704219e-02, 0.00000000e+00, 7.69691393e-02, 4.27923016e-02,
6.74339086e-02, 6.58730278e-03, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 2.63072923e-02, 0.00000000e+00,
2.20029033e-04, 5.53268157e-02, 5.87673932e-02, 0.00000000e+00,
5.43094240e-02, 2.41072252e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 5.68758138e-03, 1.18015923e-01, 0.00000000e+00,
5.01571335e-02, 2.64135972e-02, 0.00000000e+00, 0.00000000e+00,
2.56999163e-04, 0.00000000e+00, 1.12957120e-01, 0.00000000e+00,
2.90415399e-02, 3.60103175e-02, 5.20456955e-02, 7.78102502e-02,
0.00000000e+00, 0.00000000e+00, 4.75638472e-02, 1.87110100e-02,
2.96180435e-02, 4.02386934e-02, 0.00000000e+00, 0.00000000e+00,
0.00000000e+00, 0.00000000e+00, 1.19690998e-02, 0.00000000e+00,
5.11455396e-03, 0.00000000e+00, 4.28009219e-03, 3.88282314e-02,
0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,

```
       3.30027984e-03, 5.44816479e-02, 0.00000000e+00, 3.77013721e-02,
       1.42210364e-01, 0.00000000e+00, 3.34586427e-02, 1.08928159e-01,
       5.64140594e-03, 6.96678683e-02, 0.00000000e+00, 0.00000000e+00,
       0.00000000e+00, 0.00000000e+00, 5.01690321e-02, 0.00000000e+00,
       8.42940360e-02, 0.00000000e+00, 0.00000000e+00, 8.12659599e-03,
       0.00000000e+00, 0.00000000e+00, 0.00000000e+00, 1.01403594e-01,
       0.00000000e+00, 9.96318646e-04, 0.00000000e+00, 6.34986013e-02,
       1.18550994e-01, 1.12073831e-02, 5.80218323e-02, 0.00000000e+00,
       1.31945357e-01, 7.68259466e-02, 1.12981603e-01, 0.00000000e+00,
       0.00000000e+00, 0.00000000e+00, 3.38605717e-02, 2.49104109e-02]],
     dtype=float32)>
```

[83]: `model.summary()`

```
Model: "sequential"

_____
Layer (type)                 Output Shape              Param #
=================================================================
conv (Conv)                  multiple                  1024

_____
conv_1 (Conv)                multiple                  18752

_____
conv_2 (Conv)                multiple                  74368

_____
conv_3 (Conv)                multiple                  148096

_____
flatten (Flatten)            multiple                  0

_____
dense (Dense)                multiple                  3211776
=================================================================
Total params: 3,454,016
Trainable params: 3,453,312
Non-trainable params: 704

_____
```

              .

          .

[84]: `checker.model_check(model)`

            dense layer   .   .

2.6

callback   weight   . epoch weights   .

       model.load_weights()   .   Save and restore   .

2.6.1 [TODO]

　　.

- checkpoint_path, save_weights_only, save_freq .
- verbose=1 . , verbose 1 ' ' 2 ' ', ' ' 3 ' ',' ',' ' .

callback ¡'## ##" "## ##" **None** .

```
[85]: checkpoint_path = "./train/exp_cnn/cp-{epoch:04d}.ckpt"
      checkpoint_dir = os.path.dirname(checkpoint_path)

      ##      ##
      #
      cp_callback = tf.keras.callbacks.ModelCheckpoint(checkpoint_path,␣
       →save_weights_only=True, save_freq='epoch', verbose=1)
      ##      ##
```

```
[86]: checker.callback_check(cp_callback)
```

callback ! .

2.7 6. Loss function Optimizer

　　. (gradient descent) (update) .
　　.

2.7.1 [TODO]

. - `compile` model training loss optimizer . tf.Keras.Model.compile()
- `loss` SparseCategoricalCrossentropy Cross Entropy Loss loss . - `optimizer`
Adam optimizer <3. > `learning_rate` ! - `metrics` accuracy .

2.7.2 [Tensorflow 1.x 2.x]

- `loss`, `optimizer`, `metric` model.compile .

! "## ##" "## ##" **None** .

```
[87]: ##      ##
      model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate),
                    loss = tf.keras.losses.SparseCategoricalCrossentropy(from_logits=␣
       →True),
                    metrics = ['accuracy'])
      ##      ##
```

```
[88]: checker.compile_check(model)
```

compile ! .

2.8 7. Training

, GPU   , CPU   .   20~30   .

accuracy   .

2.8.1 [TODO]

. - `tf.keras.Model Method fit`   . - tf.data.Dataset   train_dataset
input   . - input tf.data   steps_per_epoch   . train_data   batch_size
   . - validation_data validation_steps   . - epochs   . - callbacks
   weight   .

! "##   ##" "##   ##"   None   .

[89]:
```
train_len = len(glob(os.path.join(PATH, 'train', folder_list[0], '*.jpg'))) * 2
val_len = len(glob(os.path.join(PATH, 'val', folder_list[0], '*.jpg'))) * 2
test_len = len(glob(os.path.join(PATH, 'test', folder_list[0], '*.jpg'))) * 2
```

[90]:
```
##      ##
model.fit(train_dataset, steps_per_epoch = train_len/batch_size,
          validation_data= val_dataset,
          validation_steps= val_epoch,
        epochs= max_epochs,
        callbacks= [cp_callback])
##      ##
```

WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at
0x000002478737AC48>> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at
0x000002478737AC48>> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'

WARNING: Entity <bound method Conv.call of <__main__.Conv object at
0x000002478737AC48>> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'
WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at
0x0000024786351708>> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at
0x0000024786351708>> could not be transformed and will be executed as-is. Please

report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <bound method Conv.call of <__main__.Conv object at 0x0000024786351708>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at 0x000002478784AE48>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at 0x000002478784AE48>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <bound method Conv.call of <__main__.Conv object at 0x000002478784AE48>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at 0x000002478783A3C8>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <bound method Conv.call of <__main__.Conv object at 0x000002478783A3C8>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'

WARNING: Entity <bound method Conv.call of <__main__.Conv object at 0x000002478783A3C8>> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: No module named 'tensorflow_core.estimator'
Train for 100.0 steps, validate for 1 steps
Epoch 1/20
WARNING:tensorflow:Entity <function Function._initialize_uninitialized_variables.<locals>.initialize_variables at 0x0000024788497168> could not be transformed and will be executed as-is. Please report this to the AutoGraph team. When filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:

```
No module named 'tensorflow_core.estimator'

WARNING:tensorflow:Entity <function
Function._initialize_uninitialized_variables.<locals>.initialize_variables at
0x0000024788497168> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'

WARNING: Entity <function
Function._initialize_uninitialized_variables.<locals>.initialize_variables at
0x0000024788497168> could not be transformed and will be executed as-is. Please
report this to the AutoGraph team. When filing the bug, set the verbosity to 10
(on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause:
No module named 'tensorflow_core.estimator'
 99/100 [============================>.] - ETA: 2s - loss: 1.1903 - accuracy:
0.5444
Epoch 00001: saving model to ./train/exp_cnn/cp-0001.ckpt
100/100 [==============================] - 229s 2s/step - loss: 1.1877 -
accuracy: 0.5450 - val_loss: 2.0185 - val_accuracy: 1.0000
Epoch 2/20
 99/100 [============================>.] - ETA: 2s - loss: 0.6322 - accuracy:
0.6753
Epoch 00002: saving model to ./train/exp_cnn/cp-0002.ckpt
100/100 [==============================] - 222s 2s/step - loss: 0.6338 -
accuracy: 0.6745 - val_loss: 0.4606 - val_accuracy: 1.0000
Epoch 3/20
 99/100 [============================>.] - ETA: 2s - loss: 0.6032 - accuracy:
0.6929
Epoch 00003: saving model to ./train/exp_cnn/cp-0003.ckpt
100/100 [==============================] - 213s 2s/step - loss: 0.6023 -
accuracy: 0.6940 - val_loss: 0.5238 - val_accuracy: 0.7000
Epoch 4/20
 99/100 [============================>.] - ETA: 2s - loss: 0.5641 - accuracy:
0.7162
Epoch 00004: saving model to ./train/exp_cnn/cp-0004.ckpt
100/100 [==============================] - 211s 2s/step - loss: 0.5629 -
accuracy: 0.7165 - val_loss: 0.8238 - val_accuracy: 0.4500
Epoch 5/20
 99/100 [============================>.] - ETA: 2s - loss: 0.5345 - accuracy:
0.7409
Epoch 00005: saving model to ./train/exp_cnn/cp-0005.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.5345 -
accuracy: 0.7405 - val_loss: 1.2632 - val_accuracy: 0.4000
Epoch 6/20
 99/100 [============================>.] - ETA: 2s - loss: 0.5158 - accuracy:
0.7535
Epoch 00006: saving model to ./train/exp_cnn/cp-0006.ckpt
100/100 [==============================] - 211s 2s/step - loss: 0.5164 -
```

```
accuracy: 0.7525 - val_loss: 1.6808 - val_accuracy: 0.4000
Epoch 7/20
 99/100 [============================>.] - ETA: 2s - loss: 0.5015 - accuracy:
0.7490
Epoch 00007: saving model to ./train/exp_cnn/cp-0007.ckpt
100/100 [==============================] - 208s 2s/step - loss: 0.5004 -
accuracy: 0.7490 - val_loss: 1.2633 - val_accuracy: 0.4000
Epoch 8/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4819 - accuracy:
0.7823
Epoch 00008: saving model to ./train/exp_cnn/cp-0008.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.4857 -
accuracy: 0.7805 - val_loss: 1.2462 - val_accuracy: 0.3000
Epoch 9/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4955 - accuracy:
0.7566
Epoch 00009: saving model to ./train/exp_cnn/cp-0009.ckpt
100/100 [==============================] - 212s 2s/step - loss: 0.4970 -
accuracy: 0.7570 - val_loss: 0.8213 - val_accuracy: 0.6500
Epoch 10/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4702 - accuracy:
0.7823
Epoch 00010: saving model to ./train/exp_cnn/cp-0010.ckpt
100/100 [==============================] - 209s 2s/step - loss: 0.4694 -
accuracy: 0.7830 - val_loss: 1.0276 - val_accuracy: 0.4500
Epoch 11/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4606 - accuracy:
0.7753
Epoch 00011: saving model to ./train/exp_cnn/cp-0011.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.4605 -
accuracy: 0.7760 - val_loss: 0.2375 - val_accuracy: 0.9000
Epoch 12/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4376 - accuracy:
0.7965
Epoch 00012: saving model to ./train/exp_cnn/cp-0012.ckpt
100/100 [==============================] - 211s 2s/step - loss: 0.4383 -
accuracy: 0.7960 - val_loss: 1.0494 - val_accuracy: 0.4000
Epoch 13/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4300 - accuracy:
0.7980
Epoch 00013: saving model to ./train/exp_cnn/cp-0013.ckpt
100/100 [==============================] - 214s 2s/step - loss: 0.4339 -
accuracy: 0.7970 - val_loss: 0.8385 - val_accuracy: 0.6500
Epoch 14/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4457 - accuracy:
0.7955
Epoch 00014: saving model to ./train/exp_cnn/cp-0014.ckpt
100/100 [==============================] - 216s 2s/step - loss: 0.4447 -
```

```
accuracy: 0.7960 - val_loss: 0.5617 - val_accuracy: 0.7000
Epoch 15/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4061 - accuracy:
0.8227
Epoch 00015: saving model to ./train/exp_cnn/cp-0015.ckpt
100/100 [==============================] - 212s 2s/step - loss: 0.4048 -
accuracy: 0.8235 - val_loss: 0.7795 - val_accuracy: 0.6500
Epoch 16/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4080 - accuracy:
0.8096
Epoch 00016: saving model to ./train/exp_cnn/cp-0016.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.4070 -
accuracy: 0.8100 - val_loss: 0.2818 - val_accuracy: 0.9500
Epoch 17/20
 99/100 [============================>.] - ETA: 2s - loss: 0.4114 - accuracy:
0.8131
Epoch 00017: saving model to ./train/exp_cnn/cp-0017.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.4110 -
accuracy: 0.8125 - val_loss: 0.9667 - val_accuracy: 0.5000
Epoch 18/20
 99/100 [============================>.] - ETA: 2s - loss: 0.3735 - accuracy:
0.8374
Epoch 00018: saving model to ./train/exp_cnn/cp-0018.ckpt
100/100 [==============================] - 210s 2s/step - loss: 0.3739 -
accuracy: 0.8375 - val_loss: 0.5836 - val_accuracy: 0.6500
Epoch 19/20
 99/100 [============================>.] - ETA: 2s - loss: 0.3840 - accuracy:
0.8258
Epoch 00019: saving model to ./train/exp_cnn/cp-0019.ckpt
100/100 [==============================] - 209s 2s/step - loss: 0.3821 -
accuracy: 0.8265 - val_loss: 1.6899 - val_accuracy: 0.3500
Epoch 20/20
 99/100 [============================>.] - ETA: 2s - loss: 0.3677 - accuracy:
0.8338
Epoch 00020: saving model to ./train/exp_cnn/cp-0020.ckpt
100/100 [==============================] - 219s 2s/step - loss: 0.3658 -
accuracy: 0.8350 - val_loss: 0.4544 - val_accuracy: 0.7500
```

[90]: <tensorflow.python.keras.callbacks.History at 0x24787573e08>

accuracy **80%**   .

                      .   .

[91]: checker.accuracy_check(model)

fit   !   .

2.9 8. Evaluation

.

2.9.1 [TODO]

5. 6. Loss function Optimizer .

```python
model = tf.keras.Sequential()

##    ##
model.add(Conv(32,3))
model.add(Conv(64,3))
model.add(Conv(128,3))
model.add(Conv(128,3))

model.add(tf.keras.layers.Flatten())  # flatten
model.add(tf.keras.layers.Dense(512, activation ='relu'))  # relu
model.add(tf.Keras.layers.Dense(2, activation='softmax'))

model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate),
              loss = tf.keras.losses.SparseCategoricalCrossentropy(from_logits=␣
  ↪True),
              metrics = ['accuracy'])
##    ##

# inputs
for images, labels in train_dataset.take(1):
    outputs = model(images, training=False)
```

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/4216581913.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
AttributeError: module 'tensorflow' has no attribute 'Keras'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\tensorflow__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\tensorflow__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib__init__.py", line 127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/4216581913.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
AttributeError: module 'tensorflow' has no attribute 'Keras'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/4216581913.py", line 11,
in <module>
    model.add(tf.Keras.layers.Dense(2, activation='softmax'))
```

```
AttributeError: module 'tensorflow' has no attribute 'Keras'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:
```

```
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2947, in _run_cell
    return runner(coro)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\async_helpers.py", line 68, in _pseudo_sync_runner
    coro.send(None)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3173, in run_cell_async
    interactivity=interactivity, compiler=compiler, result=result)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3383, in run_ast_nodes
    self.showtraceback()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1143, in structured_traceback
    chained_exceptions_tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
```

```
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
```

[109]:
```
latest = tf.train.latest_checkpoint(checkpoint_dir)
latest
```

[109]: `'./train/exp_pre_trained\\cp.ckpt'`

ERROR! Session/line number was not unique in database. History logging moved to
new session 164

[93]:
```
model.load_weights(latest)
```

[93]: `<tensorflow.python.training.tracking.util.CheckpointLoadStatus at 0x2478a495148>`

. 10epoch   **75%**   .

[ ]:
```
model.evaluate(test_dataset, steps=test_len/batch_size)
```

ERROR:root:Internal Python error in the inspect module.

Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2197355079.py", line 1,
in <module>
    model.evaluate(test_dataset, steps=test_len/batch_size)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 818, in evaluate
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo

```
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2197355079.py", line 1,
in <module>
    model.evaluate(test_dataset, steps=test_len/batch_size)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 818, in evaluate
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
```

```
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
```

```
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.


  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/2197355079.py", line 1,
in <module>
    model.evaluate(test_dataset, steps=test_len/batch_size)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 818, in evaluate
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2947, in _run_cell
    return runner(coro)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\async_helpers.py", line 68, in _pseudo_sync_runner
    coro.send(None)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3173, in run_cell_async
    interactivity=interactivity, compiler=compiler, result=result)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3383, in run_ast_nodes
    self.showtraceback()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1143, in structured_traceback
    chained_exceptions_tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
```

```
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
```

[94]:
```python
checker.test_check(model)
```

.   .

. label   .   . (ex. /)

[95]:
```python
test_batch_size = 25

for images, labels in test_dataset.take(1):
    predictions = model(images)

images = images[:test_batch_size]
labels = labels[:test_batch_size]
predictions = predictions[:test_batch_size]

labels_map = {0: 'cat', 1: 'dog'}

#
fig = plt.figure(figsize=(10, 10))
for i, (px, py, y_pred) in enumerate(zip(images, labels, predictions)):
    p = fig.add_subplot(5, 5, i+1)
    if np.argmax(y_pred.numpy()) == py.numpy():
```

```
        p.set_title("{}".format(labels_map[py.numpy()]), color='blue')
    else:
        p.set_title("{}/{}".format(labels_map[np.argmax(y_pred.numpy())],
                                   labels_map[py.numpy()]), color='red')
    p.imshow(px.numpy()*0.5+0.5)
    p.axis('off')
```

ERROR! Session/line number was not unique in database. History logging moved to new session 161

2.10   9. Transfer Learning

,   (transfer learning)   .   .
                           ?

                                   .   ,   ,   .   ,
       ,   .

              .   .   VGG16 ,   ImageNet   .

tf.keras.application   VGG16   .   .

```
[96]: conv_base = tf.keras.applications.VGG16(weights='imagenet',
                                              include_top=False,
                                              input_shape=(IMG_SIZE, IMG_SIZE, 3))
```

ImageNet   VGG16 1000   class   .   .

conv_block1
conv_block2
conv_block3
conv_block4
conv_block5
dense1 (4096)
dense2 (4096)
dense3 (1000)

tf.keras.applications.VGG16()   .   include_top   (argument)
   . include_top=False VGG16   dense1 ~ dense3   conv   .
input   layer   (general)   (feature)   dataset   .
              conv   dense   ,   dense   .   conv   argument
include_top=False .

    conv_base   dense layer   .   dense layer   conv block (
block5_conv1 ~ block5_conv3)   .

                    dense layer   .   fine tuning(   )   .
ImageNet   class   . ,   ResNet   .   fine tuning
         . ,   fine tuning   overfitting   .

2.10.1 [TODO]   : dense layer

            .

  • hidden_size = 256   dense layer hidden_size = num_class   dense layer   .
      −   layer ReLU,   softmax activation function   .

    dense layer   ! "##   ##" "##   ##"   None   .

```
[97]: model = tf.keras.Sequential()
      model.add(conv_base)
      model.add(layers.Flatten())

      #
      model.add(tf.keras.layers.Dense(256, activation='relu'))
      model.add(tf.keras.layers.Dense(2, activation='softmax'))
      #
```

```
[98]: # training variable
      for var in model.trainable_variables:
          print(var.name)
```

block1_conv1/kernel:0
block1_conv1/bias:0
```

```
block1_conv2/kernel:0
block1_conv2/bias:0
block2_conv1/kernel:0
block2_conv1/bias:0
block2_conv2/kernel:0
block2_conv2/bias:0
block3_conv1/kernel:0
block3_conv1/bias:0
block3_conv2/kernel:0
block3_conv2/bias:0
block3_conv3/kernel:0
block3_conv3/bias:0
block4_conv1/kernel:0
block4_conv1/bias:0
block4_conv2/kernel:0
block4_conv2/bias:0
block4_conv3/kernel:0
block4_conv3/bias:0
block5_conv1/kernel:0
block5_conv1/bias:0
block5_conv2/kernel:0
block5_conv2/bias:0
block5_conv3/kernel:0
block5_conv3/bias:0
dense_2/kernel:0
dense_2/bias:0
dense_3/kernel:0
dense_3/bias:0
```

VGG16   .

```
    conv_block1
    conv_block2
    conv_block3
    conv_block4
    conv_block5
    new_dense1
    new_dense2
```

conv_block5   new_dense   fine tuning   .   training layer   layer   .

```
[99]: conv_base.trainable = True
      set_trainable = False
      for layer in conv_base.layers:
          if layer.name == 'block5_conv1':
              set_trainable = True
          if set_trainable:
              layer.trainable = True
          else:
```

```
        layer.trainable = False
```

[100]:
```
# training variable
for var in model.trainable_variables:
    print(var.name)
```

block5_conv1/kernel:0
block5_conv1/bias:0
block5_conv2/kernel:0
block5_conv2/bias:0
block5_conv3/kernel:0
block5_conv3/bias:0
dense_2/kernel:0
dense_2/bias:0
dense_3/kernel:0
dense_3/bias:0

trainig flag(True, False)   conv_block5   training   .

                    .

              .

[101]:
```
checker.final_dense_check(model)
```

dense layer   !   .

2.10.2 [TODO]   :

                    .

                  ! "##   ##" "##   ##"   None   .

[ ]:
```
##      ##
model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate=learning_rate),
             loss = tf.keras.losses.SparseCategoricalCrossent,
             metrics = None)
##      ##
```

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/636853057.py", line 3,
in <module>

```
    loss = tf.keras.losses.SparseCategoricalCrossent,
AttributeError: module 'tensorflow_core.keras.losses' has no attribute
'SparseCategoricalCrossent'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
```

```
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/636853057.py", line 3,
in <module>
    loss = tf.keras.losses.SparseCategoricalCrossent,
AttributeError: module 'tensorflow_core.keras.losses' has no attribute
'SparseCategoricalCrossent'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()
```

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\tensorflow__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-packages\tensorflow__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib__init__.py", line 127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

```
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/636853057.py", line 3,
in <module>
    loss = tf.keras.losses.SparseCategoricalCrossent,
AttributeError: module 'tensorflow_core.keras.losses' has no attribute
'SparseCategoricalCrossent'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'AttributeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()
```

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2947, in _run_cell
    return runner(coro)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\async_helpers.py", line 68, in _pseudo_sync_runner
    coro.send(None)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3173, in run_cell_async
    interactivity=interactivity, compiler=compiler, result=result)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3383, in run_ast_nodes
    self.showtraceback()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1143, in structured_traceback
    chained_exceptions_tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-

```
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
```

2.10.3 [TODO]

.

validation loss   callback   . *   checkpoint_path, save_best_only,
save_weights_only

callback ¡'## ##" "## ##" **None** .

```
[102]: checkpoint_path = "./train/exp_pre_trained/cp.ckpt"
       checkpoint_dir = os.path.dirname(checkpoint_path)


       #
       ##      ##
       cp_callback = tf.keras.callbacks.ModelCheckpoint(checkpoint_dir,␣
        ↪save_best_only=True, save_weights_only=True, verbose=1)
       ##      ##
```

.   20epoch   .   transfer learning   epoch
    .   5epoch   .

```
[ ]: model.fit(train_dataset, steps_per_epoch = train_len/batch_size,
             validation_data=val_dataset,
             validation_steps=val_epoch,
             epochs= 5,
             callbacks= [cp_callback])
```

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR! Session/line number was not unique in database. History logging moved to
new session 162
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/270174523.py", line 5,
in <module>
    callbacks= [cp_callback])
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 705, in fit
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()

71

```
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.

ERROR:root:Internal Python error in the inspect module.
Below is the traceback from this internal error.


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/270174523.py", line 5,
in <module>
    callbacks= [cp_callback])
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 705, in fit
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
```

```
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3444, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\gram\AppData\Local\Temp/ipykernel_1948/270174523.py", line 5,
in <module>
    callbacks= [cp_callback])
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 705, in fit
    self._assert_compile_was_called()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow_core\python\keras\engine\training.py", line 2874, in
_assert_compile_was_called
    raise RuntimeError('You must compile your model before '
RuntimeError: You must compile your model before training/testing. Use
`model.compile(optimizer, loss)`.


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'RuntimeError' object has no attribute '_render_traceback_'


During handling of the above exception, another exception occurred:


Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3364, in run_ast_nodes
    if (await self.run_code(code, result,  async_=asy)):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3461, in run_code
    self.showtraceback(running_compiled_code=True)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1125, in structured_traceback
    tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
```

```
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2947, in _run_cell
    return runner(coro)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\async_helpers.py", line 68, in _pseudo_sync_runner
    coro.send(None)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3173, in run_cell_async
    interactivity=interactivity, compiler=compiler, result=result)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 3383, in run_ast_nodes
    self.showtraceback()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2067, in showtraceback
    value, tb, tb_offset=tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1368, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1268, in structured_traceback
    self, etype, value, tb, tb_offset, number_of_lines_of_context
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1143, in structured_traceback
    chained_exceptions_tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1082, in format_exception_as_a_whole
    last_unique, recursion_repeat = find_recursion(orig_etype, evalue, records)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 382, in find_recursion
    return len(records), 0
```

```
TypeError: object of type 'NoneType' has no len()

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\interactiveshell.py", line 2064, in showtraceback
    stb = value._render_traceback_()
AttributeError: 'TypeError' object has no attribute '_render_traceback_'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 1101, in get_records
    return _fixed_getinnerframes(etb, number_of_lines_of_context, tb_offset)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 248, in wrapped
    return f(*args, **kwargs)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\IPython\core\ultratb.py", line 281, in _fixed_getinnerframes
    records = fix_frame_records_filenames(inspect.getinnerframes(etb, context))
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1502, in
getinnerframes
    frameinfo = (tb.tb_frame,) + getframeinfo(tb, context)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 1460, in
getframeinfo
    filename = getsourcefile(frame) or getfile(frame)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 696, in
getsourcefile
    if getattr(getmodule(object, filename), '__loader__', None) is not None:
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\inspect.py", line 733, in
getmodule
    if ismodule(module) and hasattr(module, '__file__'):
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 50, in __getattr__
    module = self._load()
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\site-
packages\tensorflow\__init__.py", line 44, in _load
    module = _importlib.import_module(self.__name__)
  File "C:\ProgramData\Anaconda3\envs\tens_2\lib\importlib\__init__.py", line
127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "<frozen importlib._bootstrap>", line 1006, in _gcd_import
  File "<frozen importlib._bootstrap>", line 983, in _find_and_load
  File "<frozen importlib._bootstrap>", line 965, in _find_and_load_unlocked
ModuleNotFoundError: No module named 'tensorflow_core.estimator'
```

load   test   .

2.10.4 [**TODO**]   : dense layer

,   .

- hidden_size = 256   dense layer hidden_size = num_class   dense layer   .
  - layer ReLU,   softmax activation function   .

2.10.5   [!   ?]

"   Optimizer Loss   ?"   .   callback   Weight   .
                       .   Weight, Opimizer, Loss   ?   model.save(' ',
save_format='tf')   .   tf.keras.models.load_model(' ')   .
Save and restore   .

```
[103]: model = tf.keras.Sequential()
       model.add(conv_base)
       model.add(layers.Flatten())


       #
       model.add(tf.keras.layers.Dense(256, activation='relu'))
       model.add(tf.keras.layers.Dense(2, activation='softmax'))

       model.compile(optimizer = tf.keras.optimizers.Adam(learning_rate),
                   loss = tf.keras.losses.SparseCategoricalCrossentropy(from_logits=␣
        ↪True),
                   metrics = ['accuracy'])
       #
```

ERROR! Session/line number was not unique in database. History logging moved to
new session 163

```
[104]: model.summary()
```

```
Model: "sequential_3"
_____
Layer (type)                 Output Shape              Param #
=================================================================
vgg16 (Model)                (None, 4, 4, 512)         14714688
_____
flatten_3 (Flatten)          (None, 8192)              0
_____
dense_4 (Dense)              (None, 256)               2097408
_____
dense_5 (Dense)              (None, 2)                 514
=================================================================
Total params: 16,812,610
Trainable params: 9,177,346
```

```
Non-trainable params: 7,635,264
```
----

[105]: `model.load_weights(tf.train.latest_checkpoint(checkpoint_dir))`

[105]: `<tensorflow.python.training.tracking.util.CheckpointLoadStatus at 0x247b24fc048>`

.   95%   .   SimpleCNN   .

[106]: `model.evaluate(test_dataset, steps= test_len/batch_size)`

```
100/100 [==============================] - 400s 4s/step - loss: 0.3546 -
accuracy: 0.9610
```

[106]: `[0.3546024811267853, 0.961]`

2.11 10. Summary

.   !

. - Dataset class   customize   . - CNN   . -
. -   , ,   .

---

3 Self-Review

!

3.0.1

1.   , Jupyter Notebook `Ctrl+S` `File > Save and checkpoint`   .
2.   .   Jupyter Notebook   !   "tensorflow-cnn-project"
.   ,   "submit"   "submit.zip"   . "cnn_submission.tsv"   Pass
!
   - "cnn_submission.tsv" :   (Pass/Fail)
   - "cnn_submission.html" :   Jupyter Notebook   html
3.   `submit.zip`   .

3.0.2 Colab

1.   , Jupyter Notebook `Ctrl+S`   .
2.   .   .   ,   "submit"   "cnn_submission.tsv"
. "cnn_submission.tsv"   Pass   !
   - "cnn_submission.tsv" :   (Pass/Fail)
3.   `submit`   `cnn_submission.tsv`   .
4. Colab Notebook   > `.ipynb`   .
5.   Jupyter Notebook   .
6. 4   `File > Download as > HTML(.html)`   .
7. 3   6   , `submit.zip`   .

```python
[107]: import check_util.submit as submit
       submit.process_submit()
```

```
[ Self-Check ]   : Windows
[ Self-Check ] [  -11]        .        !  :     ,  : dense layer
 ,   :       feature     dense layer    .
[ Self-Check ]              .        .      !
```

```
[ ]:
```

```
[ ]:
```