

## ✓ Практическое задание №1

Установка необходимых пакетов:

```
!pip install -q tqdm
!pip install --upgrade --no-cache-dir gdown
!pip install tensorflow
```

```
Requirement already satisfied: gdown in /usr/local/lib/python3.10/dist-packages (4.7.1)
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from gdown) (3.13.1)
Requirement already satisfied: requests[socks] in /usr/local/lib/python3.10/dist-packages (from gdown) (2.31.0)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from gdown) (1.16.0)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from gdown) (4.66.1)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/dist-packages (from gdown) (4.11.2)
Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.10/dist-packages (from beautifulsoup4->gdown) (2.5)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (3)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (2023.11)
Requirement already satisfied: PySocks!=1.5.7,>=1.5.6 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (1.7)
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.14.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (23.5.26)
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.5.3)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (16.0.6)
Requirement already satisfied: ml-dtypes==0.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: numpy>=1.23.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.23.5)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow) (23.2)
Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.5.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.37.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.59.3)
Requirement already satisfied: tensorboard<2.15,>=2.14 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.14.1)
Requirement already satisfied: tensorflow-estimator<2.15,>=2.14.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.14.0)
Requirement already satisfied: keras<2.15,>=2.14.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.14.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.42.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (2.27.0)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (3.5.2)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (0.17.0)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow) (3.0.3)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorflow) (5.3.1)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorflow) (0.3.1)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorflow) (4.9.0)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorflow) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorflow) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorflow) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorflow) (2023.11)
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorflow) (2.1.5)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth) (0.5.1)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth) (3.2.2)
```

Монтирование Вашего Google Drive к текущему окружению:

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

Mounted at /content/drive
```

Константы, которые пригодятся в коде далее, и ссылки (gdrive идентификаторы) на предоставляемые наборы данных:

```

EVALUATE_ONLY = True
TEST_ON_LARGE_DATASET = True
TISSUE_CLASSES = ('ADI', 'BACK', 'DEB', 'LYM', 'MUC', 'MUS', 'NORM', 'STR', 'TUM')
DATASETS_LINKS = {
    'train': '1XtQzVQ5XbrfxpLHJuL0XBGJ5U7CS-cLi',
    'train_small': '1qd45xXfDwdZjktLFwQb-et-mAaFeCzOR',
    'train_tiny': '1I-2Z0uXLd4QwhZQQ1tp817Kn3J0Xgbui',
    'test': '1RfPou3pFKpuHDJZ-D9XDFzgvpUBF1Dr',
    'test_small': '1wbRsog0n7uG1HIPGLhyN-PMet2kdQ21I',
    'test_tiny': '1viiB0s041CNsAK4itvX8PnYthJ-MDnQc'
}

```

Импорт необходимых зависимостей:

```

from pathlib import Path
import numpy as np
from typing import List
from tqdm.notebook import tqdm
from time import sleep
from PIL import Image
import IPython.display
from sklearn.metrics import balanced_accuracy_score
import gdown
import os
from tensorflow.keras.applications import DenseNet121
from tensorflow.keras.layers import GlobalAveragePooling2D, Dense
from tensorflow.keras.models import Sequential
from tensorflow.keras.optimizers import Adam

```

Класс Dataset

Предназначен для работы с наборами данных, обеспечивает чтение изображений и соответствующих меток, а также формирование пакетов (батчей).

```

class Dataset:

    def __init__(self, name):
        self.name = name
        self.is_loaded = False
        current_directory = '/content/drive/My Drive/Colab Notebooks'
        file_path = os.path.join(current_directory, f"{name}.npz")
        np_obj = np.load(file_path)
        self.images = np_obj['data']
        self.labels = np_obj['labels']
        self.n_files = self.images.shape[0]
        self.is_loaded = True
        print(f'Done. Dataset {name} consists of {self.n_files} images.')

    def image(self, i):
        if self.is_loaded:
            return self.images[i, :, :, :]

    def images_seq(self, n=None):
        for i in range(self.n_files if not n else n):
            yield self.image(i)

    def random_image_with_label(self):
        i = np.random.randint(self.n_files)
        return self.image(i), self.labels[i]

    def random_batch_with_labels(self, n):
        indices = np.random.choice(self.n_files, n)
        imgs = []
        for i in indices:
            img = self.image(i)
            imgs.append(self.image(i))
        logits = np.array([self.labels[i] for i in indices])
        return np.stack(imgs), logits

    def image_with_label(self, i: int):
        return self.image(i), self.labels[i]

    def __len__(self):
        # Возвращаем общее количество изображений в наборе данных
        return len(self.images)

    def __getitem__(self, idx):
        # Возвращает элемент по указанному индексу
        return self.images[idx], self.labels[idx]

d_train_tiny = Dataset('train_small')
img, lbl = d_train_tiny.random_image_with_label()

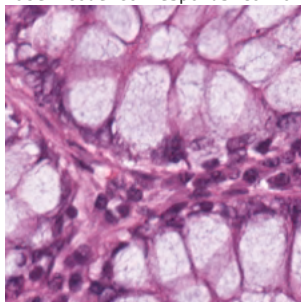
print()
print(f'Got numpy array of shape {img.shape}, and label with code {lbl}.')
print(f'Label code corresponds to {TISSUE_CLASSES[lbl]} class.')

pil_img = Image.fromarray(img)
IPython.display.display(pil_img)

```

Done. Dataset train\_small consists of 7200 images.

Got numpy array of shape (224, 224, 3), and label with code 6.  
Label code corresponds to NORM class.



## Класс Metrics

Реализует метрики точности, используемые для оценивания модели:

1. точность,
2. сбалансированную точность.

```
class Metrics:
```

```

@staticmethod
def accuracy(gt: List[int], pred: List[int]):
    assert len(gt) == len(pred), 'gt and prediction should be of equal length'
    return sum(int(i[0] == i[1]) for i in zip(gt, pred)) / len(gt)

@staticmethod
def accuracy_balanced(gt: List[int], pred: List[int]):
    return balanced_accuracy_score(gt, pred)

@staticmethod
def print_all(gt: List[int], pred: List[int], info: str):
    print(f'metrics for {info}:')
    print('\t accuracy {:.4f}'.format(Metrics.accuracy(gt, pred)))
    print('\t balanced accuracy {:.4f}'.format(Metrics.accuracy_balanced(gt, pred)))

```

Этот код определяет класс ImageClassificationModel для модели классификации изображений, используя архитектуру DenseNet121. Модель можно обучить на данных, загрузить предобученные веса из Google Drive, тестировать на датасете или отдельных изображениях. Класс также включает методы для сохранения и загрузки модели. Все это обеспечивает полный рабочий процесс создания, использования и оценки модели классификации изображений.

```

class ImageClassificationModel:

    def __init__(self, input_shape=(224, 224, 3), num_classes=9):
        # Инициализация модели с заданной формой входных данных и количеством классов
        self.model = self._create_model(input_shape, num_classes)

    def _create_model(self, input_shape, num_classes):
        # Создание базовой модели с использованием предобученной DenseNet121
        # LBL1
        base_model = DenseNet121(weights='imagenet', include_top=False, input_shape=input_shape)
        model = Sequential()
        model.add(base_model)
        model.add(GlobalAveragePooling2D())
        model.add(Dense(num_classes, activation='softmax'))
        return model

    def save_model(self, file_name: str):
        # Сохранение модели в файл
        self.model.save(f'{file_name}.h5')

    def load_model(self, model_name: str):
        # Загрузка весов модели из Google Drive
        dataset_links = {
            'best_final': '15EXSs8HLU0qDkXESSbz7r0fnxZBAVn',
            'best_small': '14BeMB19hEavJVzz2tFGGXmLpqGTKU-yJ',
            'best_tiny': '1QvwNOIWYKf0qnsHBh81nN_KtY8a3FgRy'
        }
        download_link = f"https://drive.google.com/uc?export=download&id={dataset_links.get(model_name, '')}"
        gdown.download(download_link, f'{model_name}.h5', quiet=False)
        self.model.load_weights(f'{model_name}.h5')

    def train_model(self, dataset, epochs=10, batch_size=32):
        # Обучение модели на заданном наборе данных
        self.model.compile(optimizer=Adam(), loss='sparse_categorical_crossentropy', metrics=['accuracy'])
        self.model.fit(dataset.images, dataset.labels, epochs=epochs, batch_size=batch_size)

    def test_on_dataset(self, dataset, limit=None):
        # Тестирование модели на наборе данных
        predictions = []
        n = len(dataset) if limit is None else int(len(dataset) * limit)
        for i in tqdm(range(n)):
            img, label = dataset[i]
            predictions.append(self.test_on_image(img))
        return predictions

    def test_on_image(self, img: np.ndarray):
        # Тестирование модели на отдельном изображении
        prediction = self.model.predict(np.expand_dims(img, axis=0))[0]
        return np.argmax(prediction)

```

### Классификация изображений

Используя введенные выше классы можем перейти уже непосредственно к обучению модели классификации изображений. Пример общего пайплайна решения задачи приведен ниже.

```
model = ImageClassificationModel()
```

### ✓ Обучение на *train\_tiny*

```
# Подготовка данных для обучения
#LBL2
# Предполагается, что класс Dataset уже определен и подготовлен для работы с данными
d_train_tiny = Dataset('train_tiny')

# Обучение модели с использованием подготовленных данных
model.train_model(d_train_tiny)

# Сохранение обученной модели в Google Drive
model.save_model('/content/drive/My Drive/Colab Notebooks/best_tiny')

Done. Dataset train_tiny consists of 900 images.
Epoch 1/10
29/29 [=====] - 88s 515ms/step - loss: 0.8427 - accuracy: 0.7544
Epoch 2/10
29/29 [=====] - 10s 335ms/step - loss: 0.5547 - accuracy: 0.8411
Epoch 3/10
29/29 [=====] - 10s 331ms/step - loss: 0.3532 - accuracy: 0.8789
Epoch 4/10
29/29 [=====] - 10s 333ms/step - loss: 0.3073 - accuracy: 0.9089
Epoch 5/10
29/29 [=====] - 10s 331ms/step - loss: 0.3754 - accuracy: 0.8889
Epoch 6/10
29/29 [=====] - 10s 337ms/step - loss: 0.1996 - accuracy: 0.9367
Epoch 7/10
29/29 [=====] - 10s 337ms/step - loss: 0.3160 - accuracy: 0.8967
Epoch 8/10
29/29 [=====] - 10s 339ms/step - loss: 0.2770 - accuracy: 0.9100
Epoch 9/10
29/29 [=====] - 10s 356ms/step - loss: 0.1482 - accuracy: 0.9511
Epoch 10/10
29/29 [=====] - 11s 364ms/step - loss: 0.2967 - accuracy: 0.9078
/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3079: UserWarning: You are saving your model as an HDF5 file via
saving_api.save_model(
```

### ✓ Обучение на *train\_small*

```
# Создание экземпляра модели
#LBL3
model = ImageClassificationModel()

# Загрузка весов модели 'best_tiny'
model.load_model('best_tiny')

# Подготовка данных для обучения
d_train_small = Dataset('train_small')

# Обучение модели на данных 'train_small'
model.train_model(d_train_small)

# Сохранение обученной модели в Google Drive
model.save_model('/content/drive/My Drive/Colab Notebooks/best_small')

Downloading...
From: https://drive.google.com/uc?export=download&id=1Qywn0IwyKf0qnsHBh8lnN\_KtY8a3FgRy
To: /content/best_tiny.h5
100%|██████████| 85.5M/85.5M [00:00<00:00, 103MB/s]
Done. Dataset train_small consists of 7200 images.
Epoch 1/10
225/225 [=====] - 136s 347ms/step - loss: 0.3054 - accuracy: 0.9065
Epoch 2/10
225/225 [=====] - 79s 353ms/step - loss: 0.1946 - accuracy: 0.9411
Epoch 3/10
225/225 [=====] - 79s 352ms/step - loss: 0.1518 - accuracy: 0.9519
Epoch 4/10
225/225 [=====] - 79s 352ms/step - loss: 0.1192 - accuracy: 0.9639
Epoch 5/10
225/225 [=====] - 79s 352ms/step - loss: 0.1054 - accuracy: 0.9654
Epoch 6/10
225/225 [=====] - 79s 351ms/step - loss: 0.0882 - accuracy: 0.9712
Epoch 7/10
225/225 [=====] - 79s 351ms/step - loss: 0.0921 - accuracy: 0.9683
Epoch 8/10
225/225 [=====] - 79s 351ms/step - loss: 0.0692 - accuracy: 0.9764
Epoch 9/10
225/225 [=====] - 80s 355ms/step - loss: 0.0845 - accuracy: 0.9703
Epoch 10/10
225/225 [=====] - 78s 348ms/step - loss: 0.0794 - accuracy: 0.9746
```

## Обучение на *train*

```
# Создание экземпляра модели
#LBL4
model = ImageClassificationModel()

# Загрузка весов модели 'best_small'
model.load_model('best_small')

# Подготовка данных для обучения
d_train = Dataset('train')

# Обучение модели на данных 'train'
model.train_model(d_train)

# Сохранение обученной модели в Google Drive
model.save_model('/content/drive/My Drive/Colab Notebooks/best_final')

Downloading...
From: https://drive.google.com/uc?export=download&id=14BeMB19hEavJVzz2tFGGXmLpqGTKU-yJ
To: /content/best_small.h5
100%|██████████| 85.5M/85.5M [00:00<00:00, 157MB/s]
Done. Dataset train consists of 18000 images.
Epoch 1/10
563/563 [=====] - 275s 357ms/step - loss: 0.0987 - accuracy: 0.9690
Epoch 2/10
563/563 [=====] - 197s 350ms/step - loss: 0.0755 - accuracy: 0.9747
Epoch 3/10
563/563 [=====] - 197s 350ms/step - loss: 0.0672 - accuracy: 0.9784
Epoch 4/10
563/563 [=====] - 197s 349ms/step - loss: 0.0718 - accuracy: 0.9762
Epoch 5/10
563/563 [=====] - 196s 348ms/step - loss: 0.0506 - accuracy: 0.9837
Epoch 6/10
563/563 [=====] - 196s 349ms/step - loss: 0.0447 - accuracy: 0.9852
Epoch 7/10
563/563 [=====] - 196s 348ms/step - loss: 0.0487 - accuracy: 0.9837
Epoch 8/10
563/563 [=====] - 196s 349ms/step - loss: 0.0376 - accuracy: 0.9862
Epoch 9/10
563/563 [=====] - 196s 348ms/step - loss: 0.0449 - accuracy: 0.9862
Epoch 10/10
563/563 [=====] - 196s 349ms/step - loss: 0.0340 - accuracy: 0.9881
/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3079: UserWarning: You are saving your model as an HDF5 file via
saving_api.save_model(
```

В этом коде создается модель классификации изображений, загружаются её веса из сохраненного набора, а затем она тестируется на 10% тестового набора данных. После тестирования выводятся метрики производительности модели для этой части тестовых данных.

```
# Создание экземпляра модели
model = ImageClassificationModel()

# Загрузка весов модели из предварительно обученного набора
model.load_model('best_final')

# Подготовка тестового набора данных
# Предполагается, что класс Dataset уже определен и подготовлен для работы с данными
d_test = Dataset('test')

# Тестирование модели на части тестового набора данных (10%)
pred_1 = model.test_on_dataset(d_test, limit=0.1)

# Вывод результатов метрик
# Предполагается, что класс Metrics уже определен и содержит метод print_all для вывода метрик
Metrics.print_all(d_test.labels[:len(pred_1)], pred_1, '10% of test')
```

Downloading...

From: <https://drive.google.com/uc?export=download&id=15EXSs8HLU0qDkXESSbzbz7r0fnxZBAV>

To: /content/best\_final.h5

100% [██████████] 85.5M/85.5M [00:00<00:00, 137MB/s]

Done. Dataset test consists of 4500 images.

100% 450/450 [00:42<00:00, 9.13it/s]

```
1/1 [=====] - 3s 3s/step
1/1 [=====] - 0s 32ms/step
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Этот код загружает предварительно обученные веса в модель классификации изображений, тестирует её на тестовом наборе данных, и, если включен определенный режим, выводит метрики производительности этой модели. Весь процесс включает создание модели, загрузку весов, подготовку тестовых данных, выполнение теста и отображение результатов.

```
##### TEST #####

# Создание экземпляра модели
model = ImageClassificationModel()

# Загрузка весов модели из предварительно обученного набора
model.load_model('best_final')

# Подготовка тестового набора данных
# Предполагается, что класс Dataset уже определен и подготовлен для работы с данными
d_test = Dataset('test')

# Оценка модели на полном тестовом наборе данных, если установлено TEST_ON_LARGE_DATASET
if TEST_ON_LARGE_DATASET:
    pred_2 = model.test_on_dataset(d_test)
    # Вывод результатов метрик
    # Предполагается, что класс Metrics уже определен и содержит метод print_all для вывода метрик
    Metrics.print_all(d_test.labels, pred_2, 'test')
```

Downloading...

From: <https://drive.google.com/uc?export=download&id=15EXSs8HLU0qDkXESSbzbz7r0fnxZBAV>

To: /content/best\_final.h5

100% [██████████] 85.5M/85.5M [00:00<00:00, 143MB/s]

Done. Dataset test consists of 4500 images.

100% 4500/4500 [08:06<00:00, 9.12it/s]

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```

В этом коде создается и загружается модель для классификации изображений, тестируется на специализированном тестовом наборе данных 'test\_tiny', и затем выводятся метрики для оценки её эффективности на этих данных.

```

1/1 [=====] - 0s 48ms/step

# Создание экземпляра модели
final_model = ImageClassificationModel()

# Загрузка весов модели из предварительно обученного набора
final_model.load_model('best_final')

# Подготовка тестового набора данных "test_tiny"
# Предполагается, что класс Dataset уже определен и подготовлен для работы с данными
d_test_tiny = Dataset('test_tiny')

# Тестирование модели на тестовом наборе данных "test_tiny"
pred = final_model.test_on_dataset(d_test_tiny)

# Вывод результатов метрик
# Предполагается, что класс Metrics уже определен и содержит метод print_all для вывода метрик
Metrics.print_all(d_test_tiny.labels, pred, 'test-tiny')

```

Downloading...

From: <https://drive.google.com/uc?export=download&id=15EXSs8HLU0qDkXESSbzbz7r0fnxZBAV>

To: /content/best\_final.h5

100%[██████████] 85.5M/85.5M [00:00<00:00, 258MB/s]

Done. Dataset test\_tiny consists of 90 images.

100% 90/90 [00:10<00:00, 9.19it/s]

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```

В данном коде создается экземпляр модели для классификации изображений, в который загружаются обученные веса. Затем модель тестируется на специфическом тестовом наборе данных 'test\_small', после чего выводятся соответствующие метрики производительности модели.

```
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```

```
# Создание экземпляра модели
```

```
final_model = ImageClassificationModel()
```

```
# Загрузка весов модели 'best_final'
```

```
final_model.load_model('best_final')
```

```
# Подготовка тестового набора данных 'test_small'
```

```
d_test_small = Dataset('test_small')
```

```
# Тестирование модели на тестовом наборе данных 'test_small'
```

```
pred = final_model.test_on_dataset(d_test_small)
```

```
# Вывод результатов метрик
```

```
# Предполагается, что класс Metrics уже определен и содержит метод print_all для вывода метрик
```

```
Metrics.print_all(d_test_small.labels, pred, 'test-small')
```

Downloading...

From: <https://drive.google.com/uc?export=download&id=15EXSs8HLU0qDkXESSbzbz7r0fnxZBAV>

To: /content/best\_final.h5

100% [██████████] 85.5M/85.5M [00:00<00:00, 205MB/s]

Done. Dataset test\_small consists of 1800 images.

100% 1800/1800 [02:58<00:00, 8.93it/s]

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```

В этом коде создается модель классификации изображений, загружаются её обученные веса, проводится тестирование на тестовом наборе данных и выводятся метрики для оценки производительности модели на этих данных.

```

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# Создание экземпляра модели
final_model = ImageClassificationModel()

# Загрузка весов модели 'best_final'
final_model.load_model('best_final')

# Подготовка тестового набора данных
d_test = Dataset('test')

# Тестирование модели на тестовом наборе данных
pred = final_model.test_on_dataset(d_test)

# Вывод результатов метрик
Metrics.print_all(d_test.labels, pred, 'test')

```



Downloading...

From: <https://drive.google.com/uc?export=download&id=15EXSs8HLU0qDkXESSbzbz7r0fnxZBAV>

To: /content/best\_final.h5

100% [██████████] 85.5M/85.5M [00:00&lt;00:00, 110MB/s]

Done. Dataset test consists of 4500 images.

100% 4500/4500 [08:01&lt;00:00, 10.12it/s]

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