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Лабораторная работа №3 по курсу «Проектирование интеллектуальных систем»

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Импорт библиотек:

```
import keras
from keras.datasets import cifar10
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation, Flatten
from keras.layers import Conv2D, MaxPooling2D
import os
from keras.constraints import maxnorm
from keras.optimizers import SGD
```

```
Using TensorFlow backend.
```

```
from keras.callbacks import ModelCheckpoint, TensorBoard
import datetime
```

Задаем количество эпох и объем батча:

```
batch_size = 32
num_classes = 10
epochs = 5
num_predictions = 20
```

Скачиваем датасет и приводим к виду для обучения с помощью нейронной сети:

```
(x_train, y_train), (x_test, y_test) = cifar10.load_data()
print('x_train shape:', x_train.shape)
print(x_train.shape[0], 'train samples')
print(x_test.shape[0], 'test samples')
x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train = x_train / 255.0
x_test = x_test / 255.0
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)
```

Видно, что набор состоит из 50000 тренировочных элементов и 10000 тестовых

```
x_train shape: (50000, 32, 32, 3)
50000 train samples
10000 test samples
```

Создание базовой модели:

```
def create_model():
    model = Sequential()
    model.add(Conv2D(32, (3, 3), input_shape=(32, 32, 3),
padding='same', activation='relu', kernel_constraint=maxnorm(3)))
    model.add(Dropout(0.2))
    model.add(Conv2D(64, (3, 3), activation='relu', padding='same',
kernel_constraint=maxnorm(3)))
    model.add(MaxPooling2D(pool_size=(2, 2)))
    model.add(Conv2D(128, (3, 3), input_shape=(32, 32, 3),
padding='same', activation='relu', kernel_constraint=maxnorm(3)))
    model.add(MaxPooling2D(pool_size=(2, 2)))
    model.add(Dropout(0.2))
    model.add(Flatten())
    model.add(Dense(512, activation='relu',
kernel_constraint=maxnorm(3)))
    model.add(Dropout(0.5))
    model.add(Dense(num_classes, activation='softmax'))
    lrate = 0.01
    decay = lrate/epochs
    sgd = SGD(lr=lrate, momentum=0.9, decay=decay, nesterov=False)
    model.compile(loss='categorical_crossentropy', optimizer=sgd,
metrics=['accuracy'])
    return model

model = create_model()
```

Описание модели:

model.summary()

```
WARNING:tensorflow:From /Users/paulik/Универ/giis/env/lib/python3.7/
site-packages/tensorflow_core/python/ops/
resource_variable_ops.py:1630: calling BaseResourceVariable.__init__
(from tensorflow.python.ops.resource_variable_ops) with constraint is
deprecated and will be removed in a future version.
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
WARNING:tensorflow:From /Users/paulik/Универ/giis/env/lib/python3.7/
```

```
site-packages/keras/backend/tensorflow_backend.py:4070: The name
tf.nn.max_pool is deprecated. Please use tf.nn.max_pool2d instead.

Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 32, 32, 32)        896
_________________________________________________________________
dropout_1 (Dropout)          (None, 32, 32, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 32, 32, 64)        18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 16, 16, 64)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 16, 16, 128)       73856
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 8, 8, 128)         0
_________________________________________________________________
dropout_2 (Dropout)          (None, 8, 8, 128)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 8192)              0
_________________________________________________________________
dense_1 (Dense)              (None, 512)               4194816
_________________________________________________________________
dropout_3 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_2 (Dense)              (None, 10)                5130
=================================================================
Total params: 4,293,194
Trainable params: 4,293,194
Non-trainable params: 0
_________________________________________________________________
```

Создание колбеков для чекпоинтов и тензорборда

```
checkpoint_path = "training_chekpoints/cp.ckpt"
checkpoint_dir = os.path.dirname(checkpoint_path)
```

```
# Создаем коллбек сохраняющий веса модели
cp_callback = ModelCheckpoint(filepath=checkpoint_path,

save_weights_only=True,
                                                 verbose=1, period=1)
log_dir = "logs/fit/" + datetime.datetime.now().strftime("%Y%m%d-
%H%M%S")
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)
```

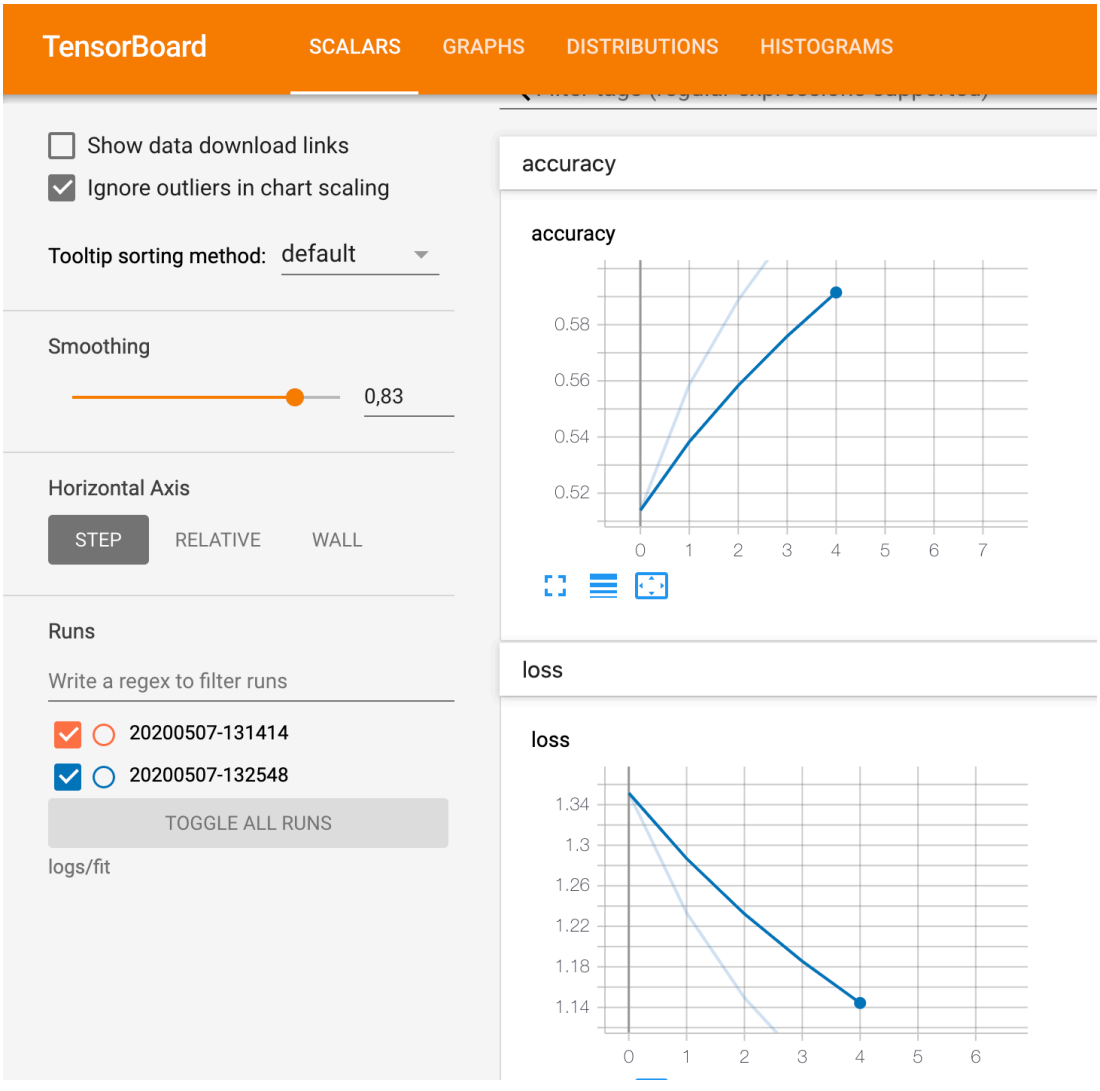
Начало тренировки модели:

```
model.fit(x_train,
          y_train,
          validation_data=(x_test, y_test),
          epochs=epochs,
          batch_size=batch_size,
          callbacks=[cp_callback, tensorboard_callback])
```

```
Train on 50000 samples, validate on 10000 samples
Epoch 1/5
50000/50000 [==============================] - 144s 3ms/step - loss:
1.3515 - accuracy: 0.5139 - val_loss: 1.2078 - val_accuracy: 0.5714

Epoch 00001: saving model to training_chekpoints/cp.ckpt
WARNING:tensorflow:From /Users/paulik/Универ/giis/env/lib/python3.7/
site-packages/keras/callbacks/tensorboard_v1.py:343: The name
tf.Summary is deprecated. Please use tf.compat.v1.Summary instead.

Epoch 2/5
50000/50000 [==============================] - 148s 3ms/step - loss:
1.2331 - accuracy: 0.5586 - val_loss: 1.1382 - val_accuracy: 0.5968

Epoch 00002: saving model to training_chekpoints/cp.ckpt
Epoch 3/5
50000/50000 [==============================] - 150s 3ms/step - loss:
1.1496 - accuracy: 0.5888 - val_loss: 1.0749 - val_accuracy: 0.6157

Epoch 00003: saving model to training_chekpoints/cp.ckpt
Epoch 4/5
```

```
50000/50000 [==============================] - 148s 3ms/step - loss:
1.0878 - accuracy: 0.6127 - val_loss: 1.0217 - val_accuracy: 0.6399

Epoch 00004: saving model to training_chekpoints/cp.ckpt
Epoch 5/5
50000/50000 [==============================] - 148s 3ms/step - loss:
1.0385 - accuracy: 0.6314 - val_loss: 0.9857 - val_accuracy: 0.6484

Epoch 00005: saving model to training_chekpoints/cp.ckpt
<keras.callbacks.callbacks.History at 0x136d04b10>
```

Вывод метрик в Tensorboard:



Сохранение полной модели

```
# os.getcwd()
save_dir = os.path.join(os.getcwd(), 'models')
print(save_dir)
model_name = 'modelpkh.h5'
model_path = os.path.join(save_dir, model_name)
model.save(model_path)
print('Saved trained model at %s ' % model_path)
```

```
/Users/paulik/Универ/giis/models
Saved trained model at /Users/paulik/Универ/giis/models/modelpkh.h5
```

```
# Score trained model.
def model_evaluate(model1):
    scores = model1.evaluate(x_test, y_test, verbose=1)
    print('Test loss:', scores[0])
    print('Test accuracy:', scores[1])
```

Проверка точности базовой модели без тренировки

```
#Ненатренированная модель
model2 = create_model()
model_evaluate(model2)
```

```
WARNING:tensorflow:From /Users/paulik/Универ/giis/env/lib/python3.7/
site-packages/keras/backend/tensorflow_backend.py:422: The name
tf.global_variables is deprecated. Please use
tf.compat.v1.global_variables instead.

10000/10000 [==============================] - 5s 520us/step
Test loss: 2.306235139465332
Test accuracy: 0.09300000220537186
```

Точность показала 9%

Теперь создадим базовую модель и загрузим веса из чекпоинтов, полученных в результате обучения

```
model_trained = create_model()
model_trained.load_weights(checkpoint_path)
model_evaluate(model_trained)
```

```
10000/10000 [==============================] - 6s 579us/step
Test loss: 0.9856774023056031
Test accuracy: 0.6484000086784363
```

Точность на тестовой выборке составила 64%

Ответы на вопросы:

1) **Как включить TensorBoard?**

tensorboard --logdir logs/fit и далее перейти по ссылке

2) **Как сбросить граф?**

tf.keras.backend.clear_session() для tfv.2.1

3) **Зачем нужны коллекции?**

Коллекция - это объект похожий на словарь, в котором мы храним элементы узлов графа.Например, в коллекцию сохраняется переменная измерения точности и входные элементы модели.

4) **Перечислите команды для добавления переменных в сводную статистику.**

Для записи дефолтных метрик:
log_dir = "logs/fit/" + datetime.datetime.now().strftime("%Y%m%d-%H%M%S")
tensorboard_callback = TensorBoard(log_dir=log_dir, histogram_freq=1)
Для записи дополнительных статистик в цикле итерации эпох используются команды:
with train_summary_writer.as_default():
tf.summary.scalar('loss', train_loss.result(), step=epoch)
tf.summary.scalar('accuracy', train_accuracy.result(), step=epoch)
(для выборки обучения, в случае тестовой: *test_summary_writer.as_default()*)

Список литературы

[1] Google. Tensorflow. 2018. Apr. url - https://www.tensorflow.org/api_docs/python/tf/train/Saver.

[2] Google. TensorBoard. 2018. Apr. url - https://www.tensorflow.org/programmers_guide/summaries_and_-

tensorboard.