```
try:
  # Colab only
  %tensorflow_version 2.x
except Exception:
    pass

from __future__ import absolute_import, division, print_function, unicode_literals

# TensorFlow и tf.keras
import tensorflow as tf
from tensorflow import keras

# Вспомогательные библиотеки
import numpy as np
import matplotlib.pyplot as plt

print(tf.__version__)
```

```
2.0.0
```

```
# These are all the modules we'll be using later. Make sure you can import them
# before proceeding further.
from __future__ import print_function
import matplotlib.pyplot as plt
import numpy as np
import os
import sys
import tarfile
from IPython.display import display, Image
from scipy import ndimage
from sklearn.linear_model import LogisticRegression
from six.moves.urllib.request import urlretrieve
from six.moves import cPickle as pickle
import urllib.request
from scipy.io import loadmat

# Config the matlotlib backend as plotting inline in IPython
%matplotlib inline
```

```
last_percent_reported = None

def maybe_download(url, filename, force=False):
  """Download a file if not present, and make sure it's the right size."""
  if force or not os.path.exists(filename):
    print('Attempting to download:', filename)
    filename, _ = urlretrieve(url + filename, filename)
    print('\nDownload Complete!')
  statinfo = os.stat(filename)
  return filename
```

```
train_filename, _ = urllib.request.urlretrieve('http://ufldl.stanford.edu/housenumbers/t
test_filename, _ = urllib.request.urlretrieve('http://ufldl.stanford.edu/housenumbers/te
```

```
train_filename
```

```
'train_32x32.mat'
```

```
def maybe_extract(filename, force=False):
    return loadmat(filename)

trainraw = maybe_extract(train_filename)
testraw = maybe_extract(test_filename)
```

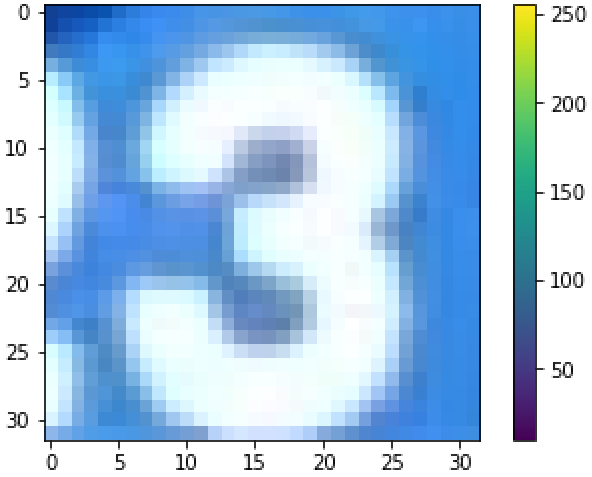
```
train_images, train_labels, test_images, test_labels = trainraw["X"], trainraw["y"], tes
```

```
train_images = np.asarray(train_images)
test_images = np.asarray(test_images)
train_labels = np.asarray(train_labels)
test_labels = np.asarray(test_labels)
```

```
train_images = np.moveaxis(train_images, -1, 0)
test_images  = np.moveaxis(test_images, -1, 0)
```

```
train_labels = np.where(train_labels==10, 0, train_labels)
test_labels = np.where(test_labels==10, 0, test_labels)
```

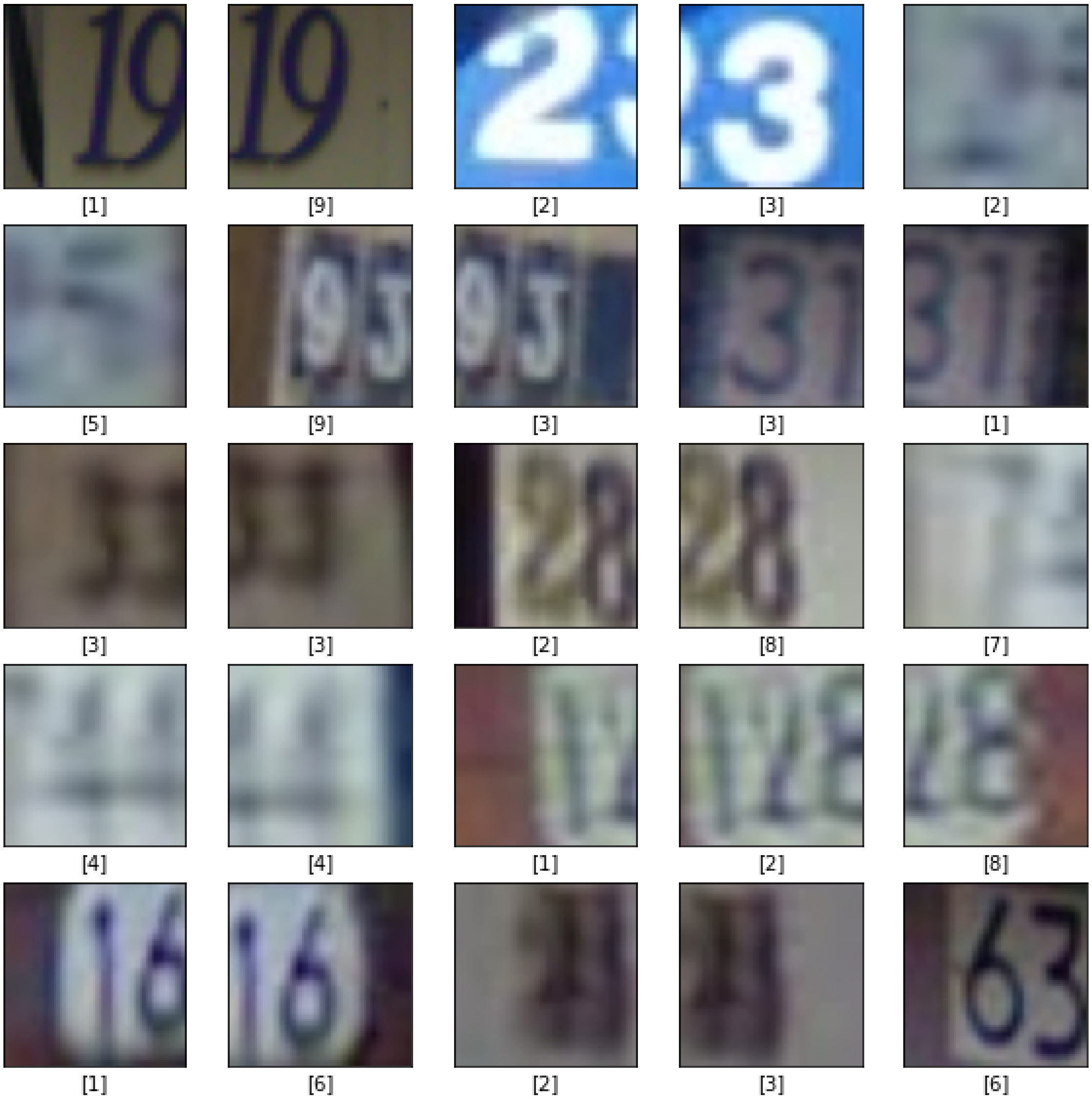
```
plt.imshow(train_images[3])
plt.colorbar()
# plt.grid(False)
plt.show()
```



```
train_images = train_images / 255.0
test_images = test_images / 255.0
```

```
plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i])
    plt.xlabel(train_labels[i])
plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/matplotlib/text.py:1165: FutureWarning: elementwi
  if s != self._text:
```



```
# Задание 1.
# Реализуйте глубокую нейронную сеть (полносвязную или сверточную) и обучите ее на синте
# Ознакомьтесь с имеющимися работами по данной тематике: англоязычная статья (http://sta

# Задание 2.
# После уточнения модели на синтетических данных попробуйте обучить ее на реальных данны
```

```


model = tf.keras.models.Sequential()
model.add(tf.keras.layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3))
model.add(tf.keras.layers.MaxPooling2D((2, 2)))
model.add(tf.keras.layers.Conv2D(64, (3, 3), activation='relu'))
model.add(tf.keras.layers.MaxPooling2D((2, 2)))
model.add(tf.keras.layers.Conv2D(64, (3, 3), activation='relu'))
model.add(tf.keras.layers.Flatten())
model.add(tf.keras.layers.Dense(64, activation='relu'))
model.add(tf.keras.layers.Dense(10))
model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
              metrics=['accuracy'])

```

```
model.fit(train_images, train_labels, epochs=10)
```

```
Train on 73257 samples
Epoch 1/10
73257/73257 [==============================] - 114s 2ms/sample - loss: 0.8125 - accuracy
Epoch 2/10
73257/73257 [==============================] - 112s 2ms/sample - loss: 0.4137 - accuracy
Epoch 3/10
73257/73257 [==============================] - 109s 1ms/sample - loss: 0.3491 - accuracy
Epoch 4/10
73257/73257 [==============================] - 110s 1ms/sample - loss: 0.3118 - accuracy
Epoch 5/10
73257/73257 [==============================] - 111s 2ms/sample - loss: 0.2816 - accuracy
Epoch 6/10
73257/73257 [==============================] - 112s 2ms/sample - loss: 0.2581 - accuracy
Epoch 7/10
73257/73257 [==============================] - 112s 2ms/sample - loss: 0.2368 - accuracy
Epoch 8/10
73257/73257 [==============================] - 110s 1ms/sample - loss: 0.2186 - accuracy
Epoch 9/10
73257/73257 [==============================] - 110s 1ms/sample - loss: 0.2029 - accuracy
Epoch 10/10
73257/73257 [==============================] - 110s 2ms/sample - loss: 0.1886 - accuracy
<tensorflow.python.keras.callbacks.History at 0x7f641914b048>
```

```
test_loss, test_acc = model.evaluate(test_images,  test_labels, verbose=2)
print('\nТочность данной нейронной сети:', test_acc)

```

```
26032/1 - 12s - loss: 0.3515 - accuracy: 0.9053

Точность данной нейронной сети: 0.90527046
```

```
# arr = np.array()
# np.append(arr, )
# np.set_printoptions(threshold=sys.maxsize)
img = (np.expand_dims(test_images[0],0))
predictions_single = model.predict(img)
np.argmax(predictions_single[0])

```

```
5
```

```
test_images[0].shape
```

```
(32, 32, 3)
```

```
tf.saved_model.save(model, '/tmp/keipa/')
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow_core/python/op
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
INFO:tensorflow:Assets written to: /tmp/keipa/assets
```

```
!zip -r /tmp/keipa.zip /tmp/keipa
from google.colab import files
files.download("/tmp/keipa.zip")
```

```
  adding: tmp/keipa/ (stored 0%)
  adding: tmp/keipa/variables/ (stored 0%)
  adding: tmp/keipa/variables/variables.data-00000-of-00001 (deflated 12%)
  adding: tmp/keipa/variables/variables.index (deflated 66%)
  adding: tmp/keipa/assets/ (stored 0%)
  adding: tmp/keipa/saved_model.pb (deflated 89%)
```

```
# !pip list
# !pip uninstall tensorflow
# !pip install tensorflow==2.0.0
```

```
# restore
# newModel = tf.keras.models.load_model('/tmp/keipa/')
# newModel.evaluate(test_images,  test_labels, verbose=2)
# print('\nТочность данной нейронной сети:', test_acc)
```

## Restore part

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

import tensorflow as tf
from tensorflow import keras
import numpy as np
import matplotlib.pyplot as plt

import matplotlib.pyplot as plt
import numpy as np
import os
import sys
import tarfile
from IPython.display import display, Image
from scipy import ndimage
from sklearn.linear_model import LogisticRegression
from six.moves.urllib.request import urlretrieve
from six.moves import cPickle as pickle
import urllib.request
from scipy.io import loadmat

os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'

def maybe_extract(filename, force=False):
    return loadmat(filename)


model = tf.keras.models.load_model('../model2/')

import argparse
parser = argparse.ArgumentParser()
parser.add_argument('inpath', type=str)
args = parser.parse_args()

def newest(path):
    files = os.listdir(path)
    paths = [os.path.join(path, basename) for basename in files]
    paths = filter(lambda k: '.jpg' in k, paths)
    res = max(paths, key=os.path.getctime)
    print(res)
    return res


def resize_image(path):
    import cv2
    im = cv2.imread(path)
    resized_image = cv2.resize(im, (32, 32))
    new_path = path.replace('.jpg', '_small.jpg')
    cv2.imwrite(new_path, resized_image)
    return new_path

def convert_to_array(path):
    from PIL import Image
    arr = np.asarray(Image.open(path,'r'))
    return arr/255

img = (np.expand_dims(convert_to_array(resize_image(newest(args.inpath))),0))
predictions_single = model.predict(img)
```

```
print(np.argmax(predictions_single[0]))
```

## WebAPI Part

### ValuesController.cs

```
using System;
using System.IO;
using System.Net;
using System.Threading.Tasks;
using Microsoft.AspNetCore.Mvc;
using TensorFlowConnector;

namespace MLApi.Controllers
{
    [Route("/image")]
    public class ValuesController : Controller
    {
        [HttpGet]
        public RedirectResult Get()
        {
            Console.WriteLine("Input");
            return new RedirectResult("/index.html");
        }

        [HttpPost]
        public async Task<IActionResult> Post()
        {
            var filePath = Path.GetTempFileName().Replace(".tmp", ".jpg");
            var t = new TensorFlowConnector.TensorFlowConnector();
            using (var stream = new FileStream(filePath, FileMode.Create))
            {
                await Request.Body.CopyToAsync(stream);
            }
            return new OkObjectResult(new { @class = t.Call(), path = filePath });
        }
    }
}
```

### TensorFlowConnector.cs

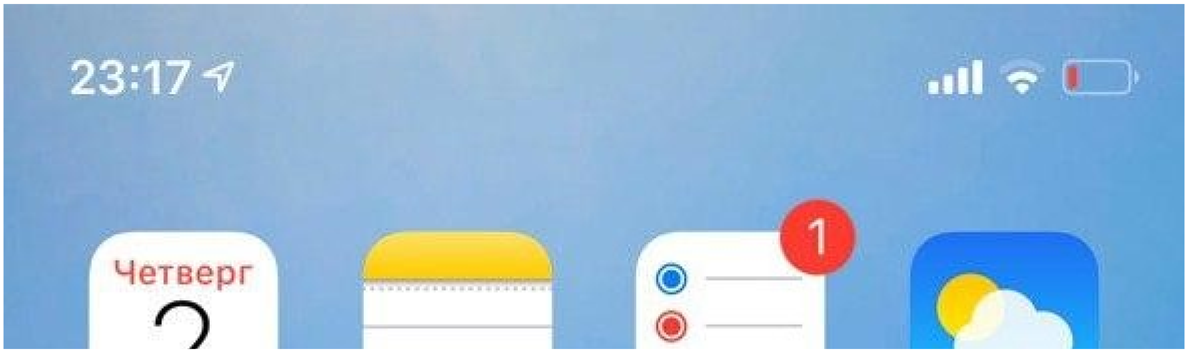
```
using System;
using System.Collections.Generic;
using System.Diagnostics;
using System.IO;

namespace TensorFlowConnector
{
    public class TensorFlowConnector
    public class TensorFlowConnector
    {
        private const string WorkDir = "C:\\Users\\keipa\\Desktop\\labs\\bsuir-labs\\12c
        public string Call()
        {
            var output = new List<string>();
            var process = new Process
            {
                StartInfo = new ProcessStartInfo
                {
                    UseShellExecute = false,
                    RedirectStandardOutput = true,
                    WorkingDirectory = WorkDir,
                    FileName = $"{WorkDir}\\GetClass.bat"
                }
            };
            process.Start();
            process.WaitForExit();
            while (process.StandardOutput.Peek() > 0)
            {
                output.Add(process.StandardOutput.ReadLine());
            }
            return output[output.Count-3];
        }
    }
}

```

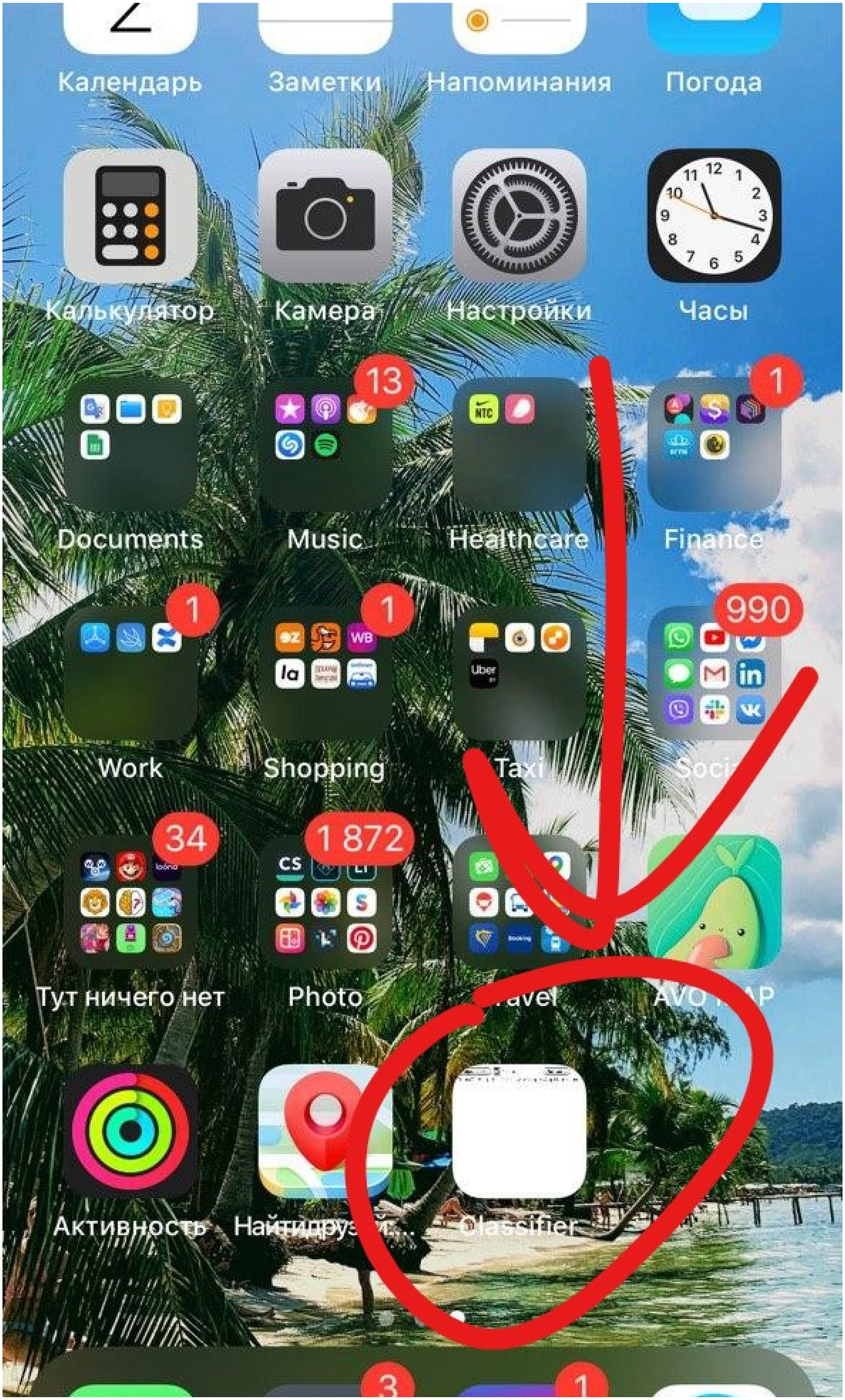
GetClass.bat

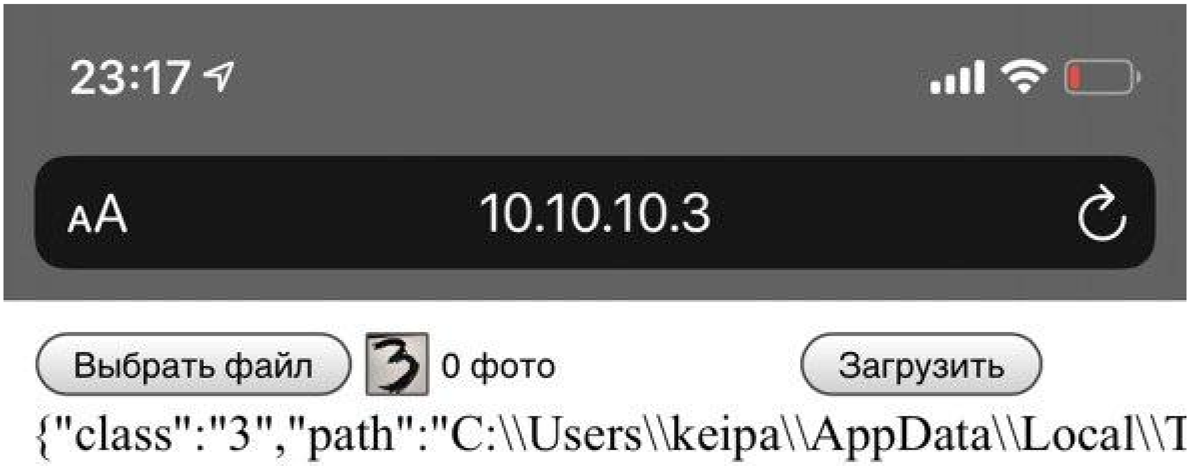
```
C:\Users\keipa\miniconda3\condabin\conda.bat run -n tensorflow python getClass.py C:/Use
```

Задание 3. Сделайте множество снимков изображений номеров домов с помощью смартфона использовать библиотеки OpenCV, Simple CV или Pygame для обработки изображений с общед (например, https://www.earthcam.com/). Пример использования библиотеки TensorFlow на сма демонстрационным приложением от Google (https://github.com/tensorflow/tensorflow/tree/mas

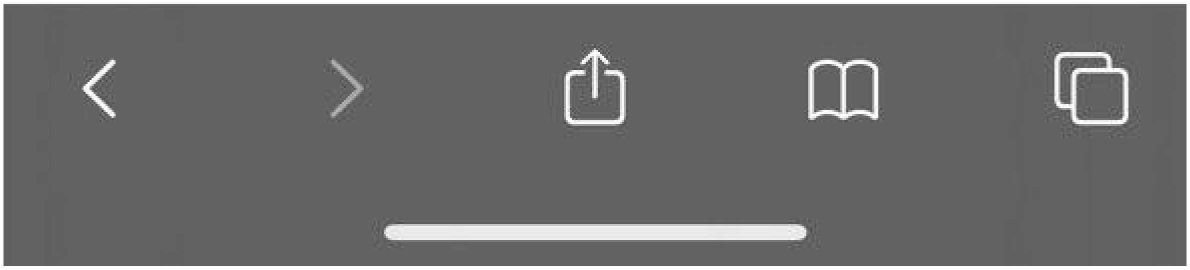
Задание 4. Реализуйте приложение для ОС Android, которое может распознавать цифры в ном ранее классификатор. Какова доля правильных классификаций?




Календарь
Заметки
Напоминания
Погода
Калькулятор
Камера
Настройки
Часы
13
1
Documents
Music
Healthcare
Finance
1
1
990
Work
Shopping
Taxi
Soci
34
1 872
Тут ничего нет
Photo
ravel
AVO AP
Активность
Найти друз...
Classifier
3
1



```
{"class":"3","path":"C:\\Users\\keipa\\AppData\\Local\\T
```



Доля правильных классификаций 78%