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/opt/ibm/dsdriver/lib:/opt/oracle/lib:/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/tensorflow\n","2022-11-16 03:06:09.558418: W tensorflow/compiler/tf2tensorrt/utils/py\_utils.cc:38] TF-TRT Warning: Cannot dlopen some TensorRT libraries. If you would like to use Nvidia GPU with TensorRT, please make sure the missing libraries mentioned above are installed properly.\n"]}],"source":["import tensorflow as tf \n","from matplotlib import pyplot as plt \n","import numpy as np"]},{"cell\_type":"markdown","metadata":{},"source":["# Load data"]},{"cell\_type":"code","execution\_count":4,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":68},"id":"TdhkobyOWmkm","outputId":"2351b0e4-0548-477b-a52d-42271f5ace9f"},"outputs":[],"source":["from keras.datasets import mnist\n","objects=mnist\n","(train\_img,train\_lab),(test\_img,test\_lab)=objects.load\_data()"]},{"cell\_type":"code","execution\_count":5,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":264},"id":"L4YAkbGHWpTH","outputId":"56227554-d52c-4aa1-8f87-dafe59c94f11"},"outputs":[{"data":{"image/png":"","text/plain":["<Figure size 432x288 with 20 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',test\_img.shape)"]},{"cell\_type":"code","execution\_count":7,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":986},"id":"QL\_NyUFAWxRe","outputId":"4e8a6236-e4ce-448a-d1ec-510162aa3ed5"},"outputs":[{"name":"stdout","output\_type":"stream","text":["How image looks like : \n","[[ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 3 18 18 18 126 136\n"," 175 26 166 255 247 127 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 30 36 94 154 170 253 253 253 253 253\n"," 225 172 253 242 195 64 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 49 238 253 253 253 253 253 253 253 253 251\n"," 93 82 82 56 39 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 18 219 253 253 253 253 253 198 182 247 241\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 80 156 107 253 253 205 11 0 43 154\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 14 1 154 253 90 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 139 253 190 2 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 11 190 253 70 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 35 241 225 160 108 1\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 81 240 253 253 119\n"," 25 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 45 186 253 253\n"," 150 27 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 16 93 252\n"," 253 187 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 249\n"," 253 249 64 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 46 130 183 253\n"," 253 207 2 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 39 148 229 253 253 253\n"," 250 182 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 24 114 221 253 253 253 253 201\n"," 78 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 23 66 213 253 253 253 253 198 81 2\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 18 171 219 253 253 253 253 195 80 9 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 55 172 226 253 253 253 253 244 133 11 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 136 253 253 253 212 135 132 16 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]\n"," [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0\n"," 0 0 0 0 0 0 0 0 0 0]]\n"]}],"source":["print('How image looks like : ')\n","print(train\_img[0])"]},{"cell\_type":"code","execution\_count":8,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":314},"id":"cLOElvPEW1oo","outputId":"d857fed9-b707-4dd2-deba-dad6852f09d5"},"outputs":[{"data":{"text/plain":["Text(0.5, 0, 'Intensity')"]},"execution\_count":8,"metadata":{},"output\_type":"execute\_result"},{"data":{"image/png":"","text/plain":["<Figure size 432x288 with 1 Axes>"]},"metadata":{"needs\_background":"light"},"output\_type":"display\_data"}],"source":["plt.hist(train\_img[0].reshape(784),facecolor='orange')\n","plt.title('Pixel vs its intensity',fontsize=16)\n","plt.ylabel('PIXEL')\n","plt.xlabel('Intensity')"]},{"cell\_type":"code","execution\_count":9,"metadata":{"id":"SRbybKR-W6TH"},"outputs":[],"source":["train\_img=train\_img/255.0\n","test\_img=test\_img/255.0"]},{"cell\_type":"code","execution\_count":10,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":1000},"id":"CXe5ypTGW-7D","outputId":"deda26f0-77c5-47c4-e211-5a1178171ddc"},"outputs":[{"name":"stdout","output\_type":"stream","text":["How image looks like after normalising: \n","[[0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0.01176471 0.07058824 0.07058824 0.07058824 0.49411765 0.53333333\n"," 0.68627451 0.10196078 0.65098039 1. 0.96862745 0.49803922\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0.11764706 0.14117647 0.36862745 0.60392157\n"," 0.66666667 0.99215686 0.99215686 0.99215686 0.99215686 0.99215686\n"," 0.88235294 0.6745098 0.99215686 0.94901961 0.76470588 0.25098039\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0.19215686 0.93333333 0.99215686 0.99215686 0.99215686\n"," 0.99215686 0.99215686 0.99215686 0.99215686 0.99215686 0.98431373\n"," 0.36470588 0.32156863 0.32156863 0.21960784 0.15294118 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0.07058824 0.85882353 0.99215686 0.99215686 0.99215686\n"," 0.99215686 0.99215686 0.77647059 0.71372549 0.96862745 0.94509804\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0.31372549 0.61176471 0.41960784 0.99215686\n"," 0.99215686 0.80392157 0.04313725 0. 0.16862745 0.60392157\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0.05490196 0.00392157 0.60392157\n"," 0.99215686 0.35294118 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.54509804\n"," 0.99215686 0.74509804 0.00784314 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.04313725\n"," 0.74509804 0.99215686 0.2745098 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0.1372549 0.94509804 0.88235294 0.62745098 0.42352941 0.00392157\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0.31764706 0.94117647 0.99215686 0.99215686 0.46666667\n"," 0.09803922 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0.17647059 0.72941176 0.99215686 0.99215686\n"," 0.58823529 0.10588235 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0.0627451 0.36470588 0.98823529\n"," 0.99215686 0.73333333 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.97647059\n"," 0.99215686 0.97647059 0.25098039 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0.18039216 0.50980392 0.71764706 0.99215686\n"," 0.99215686 0.81176471 0.00784314 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0.15294118 0.58039216 0.89803922 0.99215686 0.99215686 0.99215686\n"," 0.98039216 0.71372549 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0.09411765 0.44705882\n"," 0.86666667 0.99215686 0.99215686 0.99215686 0.99215686 0.78823529\n"," 0.30588235 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0.09019608 0.25882353 0.83529412 0.99215686\n"," 0.99215686 0.99215686 0.99215686 0.77647059 0.31764706 0.00784314\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0.07058824 0.67058824 0.85882353 0.99215686 0.99215686 0.99215686\n"," 0.99215686 0.76470588 0.31372549 0.03529412 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0.21568627 0.6745098\n"," 0.88627451 0.99215686 0.99215686 0.99215686 0.99215686 0.95686275\n"," 0.52156863 0.04313725 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0.53333333 0.99215686\n"," 0.99215686 0.99215686 0.83137255 0.52941176 0.51764706 0.0627451\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]\n"," [0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. 0. 0.\n"," 0. 0. 0. 0. ]]\n"]}],"source":["print('How image looks like after normalising: ')\n","print(train\_img[0])"]},{"cell\_type":"markdown","metadata":{},"source":["# Reshaping Dataset"]},{"cell\_type":"code","execution\_count":11,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":314},"id":"thMOXsv\_XD5z","outputId":"9edb96f0-b307-41db-a404-4a87c4bedf19"},"outputs":[{"data":{"text/plain":["Text(0.5, 0, 'Intensity')"]},"execution\_count":11,"metadata":{},"output\_type":"execute\_result"},{"data":{"image/png":"","text/plain":["<Figure size 432x288 with 1 Axes>"]},"metadata":{"needs\_background":"light"},"output\_type":"display\_data"}],"source":["plt.hist(train\_img[0].reshape(784),facecolor='orange')\n","plt.title('Pixel vs its 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metrics=['accuracy'])"]},{"cell\_type":"markdown","metadata":{},"source":["# Train the model"]},{"cell\_type":"code","execution\_count":14,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":1000},"id":"pnzlVoufXSOc","outputId":"5c3e1966-ea96-4d18-fd78-2638e17a4c8d"},"outputs":[{"name":"stdout","output\_type":"stream","text":["Epoch 1/50\n","1875/1875 [==============================] - 12s 6ms/step - loss: 0.1838 - accuracy: 0.9444\n","Epoch 2/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0805 - accuracy: 0.9746\n","Epoch 3/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0555 - accuracy: 0.9823\n","Epoch 4/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0427 - accuracy: 0.9857\n","Epoch 5/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0345 - accuracy: 0.9885\n","Epoch 6/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0285 - accuracy: 0.9909\n","Epoch 7/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0247 - accuracy: 0.9919\n","Epoch 8/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0220 - accuracy: 0.9929\n","Epoch 9/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0187 - accuracy: 0.9946\n","Epoch 10/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0200 - accuracy: 0.9942\n","Epoch 11/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0187 - accuracy: 0.9944\n","Epoch 12/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0155 - accuracy: 0.9955\n","Epoch 13/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0163 - accuracy: 0.9949\n","Epoch 14/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0131 - accuracy: 0.9964\n","Epoch 15/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0166 - accuracy: 0.9953\n","Epoch 16/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0138 - accuracy: 0.9963\n","Epoch 17/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0107 - accuracy: 0.9968\n","Epoch 18/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0145 - accuracy: 0.9958\n","Epoch 19/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0089 - accuracy: 0.9975\n","Epoch 20/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0136 - accuracy: 0.9967\n","Epoch 21/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0106 - accuracy: 0.9970\n","Epoch 22/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0152 - accuracy: 0.9965\n","Epoch 23/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0105 - accuracy: 0.9976\n","Epoch 24/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0099 - accuracy: 0.9977\n","Epoch 25/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0118 - accuracy: 0.9972\n","Epoch 26/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0127 - accuracy: 0.9974\n","Epoch 27/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0123 - accuracy: 0.9975\n","Epoch 28/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0117 - accuracy: 0.9974\n","Epoch 29/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0129 - accuracy: 0.9974\n","Epoch 30/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0100 - accuracy: 0.9981\n","Epoch 31/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0105 - accuracy: 0.9980\n","Epoch 32/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0097 - accuracy: 0.9977\n","Epoch 33/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0087 - accuracy: 0.9981\n","Epoch 34/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0148 - accuracy: 0.9976\n","Epoch 35/50\n","1875/1875 [==============================] - 10s 6ms/step - loss: 0.0137 - accuracy: 0.9975\n","Epoch 36/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0124 - accuracy: 0.9976\n","Epoch 37/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0089 - accuracy: 0.9981\n","Epoch 38/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0104 - accuracy: 0.9978\n","Epoch 39/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0122 - accuracy: 0.9980\n","Epoch 40/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0073 - accuracy: 0.9984\n","Epoch 41/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0106 - accuracy: 0.9980\n","Epoch 42/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0076 - accuracy: 0.9988\n","Epoch 43/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0129 - accuracy: 0.9979\n","Epoch 44/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0083 - accuracy: 0.9985\n","Epoch 45/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0105 - accuracy: 0.9981\n","Epoch 46/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0073 - accuracy: 0.9987\n","Epoch 47/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0088 - accuracy: 0.9985\n","Epoch 48/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0168 - accuracy: 0.9978\n","Epoch 49/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0073 - accuracy: 0.9989\n","Epoch 50/50\n","1875/1875 [==============================] - 11s 6ms/step - loss: 0.0097 - accuracy: 0.9982\n"]},{"data":{"text/plain":["<keras.callbacks.History at 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538 kB 18.8 MB/s eta 0:00:01\n","\u001b[?25hRequirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)\n","Requirement already satisfied: pandas in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.3.4)\n","Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)\n","Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)\n","Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)\n","Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)\n","Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)\n","Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)\n","Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)\n","Requirement already satisfied: botocore<1.22.0,>=1.21.21 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (1.21.41)\n","Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.10.0)\n","Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.5.0)\n","Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (2.8.2)\n","Requirement already satisfied: six>=1.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from python-dateutil<3.0.0,>=2.1->botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (1.15.0)\n","Requirement already satisfied: ibm-cos-sdk-core==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)\n","Requirement already satisfied: ibm-cos-sdk-s3transfer==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)\n","Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (2.0.4)\n","Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (3.3)\n","Requirement already satisfied: pytz>=2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (2021.3)\n","Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (1.20.3)\n","Installing collected packages: watson-machine-learning-client\n","Successfully installed watson-machine-learning-client-1.0.391\n"]}],"source":["!pip install watson-machine-learning-client --upgrade"]},{"cell\_type":"markdown","metadata":{},"source":["# Cloud Deployment"]},{"cell\_type":"code","execution\_count":38,"metadata":{},"outputs":[],"source":["from ibm\_watson\_machine\_learning import APIClient\n","\n","wml\_credentials = {\n"," \"url\": \"https://us-south.ml.cloud.ibm.com\",\n"," \"apikey\":\"\"\n","}\n","\n","client = APIClient(wml\_credentials)"]},{"cell\_type":"code","execution\_count":46,"metadata":{},"outputs":[],"source":["client = APIClient(wml\_credentials)"]},{"cell\_type":"code","execution\_count":44,"metadata":{},"outputs":[],"source":["def guid\_from\_space\_name(client, space\_name):\n"," space = client.spaces.get\_details()\n"," #print(space)\n"," return(next(item for item in space['resources'] if item['entity'][\"name\"] == space\_name)['metadata']['id'])"]},{"cell\_type":"code","execution\_count":53,"metadata":{},"outputs":[{"name":"stdout","output\_type":"stream","text":["Space UID = 7c969e94-0a62-4ce0-9390-fdc32f6be85f\n"]}],"source":["space\_uid = guid\_from\_space\_name(client, \"handwritten-digit-recognition\")\n","print(\"Space UID = \" + space\_uid)"]},{"cell\_type":"code","execution\_count":54,"metadata":{},"outputs":[{"data":{"text/plain":["'SUCCESS'"]},"execution\_count":54,"metadata":{},"output\_type":"execute\_result"}],"source":["client.set.default\_space(space\_uid)"]},{"cell\_type":"code","execution\_count":55,"metadata":{},"outputs":[{"name":"stdout","output\_type":"stream","text":["----------------------------- ------------------------------------ ----\n","NAME ASSET\_ID TYPE\n","default\_py3.6 0062b8c9-8b7d-44a0-a9b9-46c416adcbd9 base\n","kernel-spark3.2-scala2.12 020d69ce-7ac1-5e68-ac1a-31189867356a base\n","pytorch-onnx\_1.3-py3.7-edt 069ea134-3346-5748-b513-49120e15d288 base\n","scikit-learn\_0.20-py3.6 09c5a1d0-9c1e-4473-a344-eb7b665ff687 base\n","spark-mllib\_3.0-scala\_2.12 09f4cff0-90a7-5899-b9ed-1ef348aebdee base\n","pytorch-onnx\_rt22.1-py3.9 0b848dd4-e681-5599-be41-b5f6fccc6471 base\n","ai-function\_0.1-py3.6 0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda base\n","shiny-r3.6 0e6e79df-875e-4f24-8ae9-62dcc2148306 base\n","tensorflow\_2.4-py3.7-horovod 1092590a-307d-563d-9b62-4eb7d64b3f22 base\n","pytorch\_1.1-py3.6 10ac12d6-6b30-4ccd-8392-3e922c096a92 base\n","tensorflow\_1.15-py3.6-ddl 111e41b3-de2d-5422-a4d6-bf776828c4b7 base\n","autoai-kb\_rt22.2-py3.10 125b6d9a-5b1f-5e8d-972a-b251688ccf40 base\n","runtime-22.1-py3.9 12b83a17-24d8-5082-900f-0ab31fbfd3cb base\n","scikit-learn\_0.22-py3.6 154010fa-5b3b-4ac1-82af-4d5ee5abbc85 base\n","default\_r3.6 1b70aec3-ab34-4b87-8aa0-a4a3c8296a36 base\n","pytorch-onnx\_1.3-py3.6 1bc6029a-cc97-56da-b8e0-39c3880dbbe7 base\n","kernel-spark3.3-r3.6 1c9e5454-f216-59dd-a20e-474a5cdf5988 base\n","pytorch-onnx\_rt22.1-py3.9-edt 1d362186-7ad5-5b59-8b6c-9d0880bde37f base\n","tensorflow\_2.1-py3.6 1eb25b84-d6ed-5dde-b6a5-3fbdf1665666 base\n","spark-mllib\_3.2 20047f72-0a98-58c7-9ff5-a77b012eb8f5 base\n","tensorflow\_2.4-py3.8-horovod 217c16f6-178f-56bf-824a-b19f20564c49 base\n","runtime-22.1-py3.9-cuda 26215f05-08c3-5a41-a1b0-da66306ce658 base\n","do\_py3.8 295addb5-9ef9-547e-9bf4-92ae3563e720 base\n","autoai-ts\_3.8-py3.8 2aa0c932-798f-5ae9-abd6-15e0c2402fb5 base\n","tensorflow\_1.15-py3.6 2b73a275-7cbf-420b-a912-eae7f436e0bc base\n","kernel-spark3.3-py3.9 2b7961e2-e3b1-5a8c-a491-482c8368839a base\n","pytorch\_1.2-py3.6 2c8ef57d-2687-4b7d-acce-01f94976dac1 base\n","spark-mllib\_2.3 2e51f700-bca0-4b0d-88dc-5c6791338875 base\n","pytorch-onnx\_1.1-py3.6-edt 32983cea-3f32-4400-8965-dde874a8d67e base\n","spark-mllib\_3.0-py37 36507ebe-8770-55ba-ab2a-eafe787600e9 base\n","spark-mllib\_2.4 390d21f8-e58b-4fac-9c55-d7ceda621326 base\n","autoai-ts\_rt22.2-py3.10 396b2e83-0953-5b86-9a55-7ce1628a406f base\n","xgboost\_0.82-py3.6 39e31acd-5f30-41dc-ae44-60233c80306e base\n","pytorch-onnx\_1.2-py3.6-edt 40589d0e-7019-4e28-8daa-fb03b6f4fe12 base\n","pytorch-onnx\_rt22.2-py3.10 40e73f55-783a-5535-b3fa-0c8b94291431 base\n","default\_r36py38 41c247d3-45f8-5a71-b065-8580229facf0 base\n","autoai-ts\_rt22.1-py3.9 4269d26e-07ba-5d40-8f66-2d495b0c71f7 base\n","autoai-obm\_3.0 42b92e18-d9ab-567f-988a-4240ba1ed5f7 base\n","pmml-3.0\_4.3 493bcb95-16f1-5bc5-bee8-81b8af80e9c7 base\n","spark-mllib\_2.4-r\_3.6 49403dff-92e9-4c87-a3d7-a42d0021c095 base\n","xgboost\_0.90-py3.6 4ff8d6c2-1343-4c18-85e1-689c965304d3 base\n","pytorch-onnx\_1.1-py3.6 50f95b2a-bc16-43bb-bc94-b0bed208c60b base\n","autoai-ts\_3.9-py3.8 52c57136-80fa-572e-8728-a5e7cbb42cde base\n","spark-mllib\_2.4-scala\_2.11 55a70f99-7320-4be5-9fb9-9edb5a443af5 base\n","spark-mllib\_3.0 5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9 base\n","autoai-obm\_2.0 5c2e37fa-80b8-5e77-840f-d912469614ee base\n","spss-modeler\_18.1 5c3cad7e-507f-4b2a-a9a3-ab53a21dee8b base\n","cuda-py3.8 5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e base\n","autoai-kb\_3.1-py3.7 632d4b22-10aa-5180-88f0-f52dfb6444d7 base\n","pytorch-onnx\_1.7-py3.8 634d3cdc-b562-5bf9-a2d4-ea90a478456b base\n","----------------------------- ------------------------------------ ----\n","Note: Only first 50 records were displayed. To display more use 'limit' parameter.\n"]}],"source":["client.software\_specifications.list()"]},{"cell\_type":"code","execution\_count":56,"metadata":{},"outputs":[{"data":{"text/plain":["'12b83a17-24d8-5082-900f-0ab31fbfd3cb'"]},"execution\_count":56,"metadata":{},"output\_type":"execute\_result"}],"source":["software\_spec\_uid = client.software\_specifications.get\_uid\_by\_name(\"runtime-22.1-py3.9\")\n","software\_spec\_uid"]},{"cell\_type":"code","execution\_count":57,"metadata":{},"outputs":[{"name":"stdout","output\_type":"stream","text":["This method is deprecated, please use get\_model\_id()\n"]}],"source":["model\_details = client.repository.store\_model(model='project.tgz',meta\_props={\n"," client.repository.ModelMetaNames.NAME: \"CNN\",\n"," client.repository.ModelMetaNames.TYPE: \"tensorflow\_2.7\",\n"," client.repository.ModelMetaNames.SOFTWARE\_SPEC\_UID: software\_spec\_uid}\n"," )\n","\n","model\_id = client.repository.get\_model\_uid(model\_details)"]},{"cell\_type":"markdown","metadata":{},"source":[]},{"cell\_type":"code","execution\_count":58,"metadata":{},"outputs":[{"data":{"text/plain":["'40ea5a7a-fc21-493a-b043-d14aaf7c48df'"]},"execution\_count":58,"metadata":{},"output\_type":"execute\_result"}],"source":["model\_id"]},{"cell\_type":"code","execution\_count":59,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":51},"id":"xbjZ5ps6fyOc","outputId":"b261855d-aa08-4570-9428-fc64ea85dfc6"},"outputs":[{"name":"stdout","output\_type":"stream","text":["313/313 - 1s - loss: 0.2674 - accuracy: 0.9820 - 744ms/epoch - 2ms/step\n","Test Loss 0.26743024587631226\n","Test Accuracy 0.9819999933242798\n"]}],"source":["loss\_and\_acc=model.evaluate(test\_img,test\_lab,verbose=2)\n","print(\"Test Loss\", loss\_and\_acc[0])\n","print(\"Test Accuracy\", loss\_and\_acc[1])"]},{"cell\_type":"code","execution\_count":60,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":298},"id":"X9FeGNIWfz4U","outputId":"90ee6fda-72d4-4ba9-d4a3-4af880190746"},"outputs":[{"name":"stdout","output\_type":"stream","text":["313/313 [==============================] - 1s 2ms/step\n","Predicted Value: 7\n","Successful prediction\n"]},{"data":{"image/png":"","text/plain":["<Figure size 432x288 with 1 Axes>"]},"metadata":{"needs\_background":"light"},"output\_type":"display\_data"}],"source":["plt.imshow(test\_img[0],cmap='gray\_r')\n","plt.title('Actual Value: {}'.format(test\_lab[0]))\n","prediction=model.predict(test\_img)\n","plt.axis('off')\n","print('Predicted Value: ',np.argmax(prediction[0]))\n","if(test\_lab[0]==(np.argmax(prediction[0]))):\n"," print('Successful prediction')\n","else:\n"," print('Unsuccessful prediction')"]},{"cell\_type":"code","execution\_count":61,"metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":298},"id":"MpL5RJP7f5lX","outputId":"c13bfcf3-2d67-4f70-c46f-461845d3c56f"},"outputs":[{"name":"stdout","output\_type":"stream","text":["313/313 [==============================] - 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It includes your credentials.\n","# You might want to remove those credentials before you share the notebook.\n","cos\_client = ibm\_boto3.client(service\_name='s3',\n"," ibm\_api\_key\_id='is\_QZGPyU8oxZr3W-td-LCHXS3QPMaWArILi18FdSyGT',\n"," ibm\_auth\_endpoint=\"https://iam.cloud.ibm.com/oidc/token\",\n"," config=Config(signature\_version='oauth'),\n"," endpoint\_url='https://s3.private.ap.cloud-object-storage.appdomain.cloud')\n","\n","bucket = 'handwrittenimagerecognition-donotdelete-pr-8tlrnykut46vpi'\n","object\_key = 'mnist-dataset-1024x424 (2).png'\n","\n","streaming\_body\_1 = cos\_client.get\_object(Bucket=bucket, Key=object\_key)['Body']\n","\n","# Your data file was loaded into a botocore.response.StreamingBody object.\n","# Please read the documentation of ibm\_boto3 and pandas to learn more about the possibilities to load the data.\n","# ibm\_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/\n","# pandas documentation: http://pandas.pydata.org/"]},{"cell\_type":"code","execution\_count":73,"metadata":{},"outputs":[],"source":["img = Image.open(streaming\_body\_1).convert(\"L\") # convert image to monochrome\n","img = img.resize( (28,28) ) # resizing of input image"]},{"cell\_type":"code","execution\_count":74,"metadata":{},"outputs":[{"data":{"image/png":"","text/plain":["<PIL.Image.Image image mode=L size=28x28 at 0x7F674E978100>"]},"execution\_count":74,"metadata":{},"output\_type":"execute\_result"}],"source":["img"]},{"cell\_type":"code","execution\_count":75,"metadata":{},"outputs":[],"source":["im2arr = np.array(img) #converting to image\n","im2arr = im2arr.reshape(1, 28, 28, 1) #reshaping according to our requirement"]},{"cell\_type":"code","execution\_count":76,"metadata":{},"outputs":[{"name":"stdout","output\_type":"stream","text":["1/1 [==============================] - 0s 71ms/step\n","[[1. 0. 0. 0. 0. 0. 0. 0. 0. 0.]]\n"]}],"source":["pred = model.predict(im2arr)\n","print(pred)"]},{"cell\_type":"code","execution\_count":77,"metadata":{},"outputs":[{"name":"stdout","output\_type":"stream","text":["[0]\n"]}],"source":["print(np.argmax(pred, axis=1)) #printing our Labels"]}],"metadata":{"colab":{"provenance":[]},"kernelspec":{"display\_name":"Python 3.9","language":"python","name":"python3"},"language\_info":{"codemirror\_mode":{"name":"ipython","version":3},"file\_extension":".py","mimetype":"text/x-python","name":"python","nbconvert\_exporter":"python","pygments\_lexer":"ipython3","version":"3.9.13"}},"nbformat":4,"nbformat\_minor":1}