

```

{
  "nbformat": 4,
  "nbformat_minor": 0,
  "metadata": {
    "colab": { "provenance":
      [], "toc_visible": true
    },
    "kernelspec": { "name":
      "python3",
      "display_name": "Python 3"
    },
    "language_info": {
      "name": "python"
    }
  },
  "cells": [
    {
      "cell_type": "markdown",
      "source": [
        "Sprint 2"
      ],
      "metadata": {
        "id": "bAPYJfv1ge3U"
      }
    },
    {
      "cell_type": "markdown",
      "source": [
        "Team id: PNT2022TMID25747"
      ],
      "metadata": {
        "id": "25vwDtOkgiUT"
      }
    },
    {
      "cell_type": "markdown",
      "source": [
        "Libraries"
      ],
      "metadata": {
        "id": "3014sV0Pg7gW"
      }
    },
    {
      "cell_type": "code",
      "execution_count": 1,
      "metadata": {
        "id": "GUAqTqHWTJve"
      },
      "outputs": [],
      "source": [
        "import numpy as np\n",
        "import tensorflow \n",
        "from tensorflow.keras.datasets import mnist \n",
        "from tensorflow.keras.models import Sequential \n",
        "from tensorflow.keras import layers \n",
        "from tensorflow.keras.layers import Dense, Flatten \n",

```

```

        "from tensorflow.keras.layers import Conv2D \n", "from keras.
        utils import np_utils \n",
        "import matplotlib.pyplot as plt
    ]
},
{
    "cell_type": "markdown",
    "source": [
        "Load the Data"
    ],
    "metadata": {
        "id": "0zIRTLkug-CT"
    }
},
{
    "cell_type": "code",
    "source": [
        "(x_train, y_train), (x_test, y_test)=mnist.load_data ()\n", "x_train=x_train.reshape
        (60000, 28, 28, 1).astype('float32')\n",
        "x_test=x_test.reshape (10000, 28, 28, 1).astype ('float32')\n", "\n",
        "x_train.shape"
    ],
    "metadata": {
        "colab": {
            "base_uri": "https://localhost:8080/"
        },
        "id": "vXYh1tD4c1Eq",
        "outputId": "6565e34a-8a8e-42e0-97c1-d6a8c2537c85"
    },
    "execution_count": 19,
    "outputs": [
        {
            "output_type": "execute_result", "data": {
                "text/plain": [ "(60000, 28,
                28, 1)"
            ]
        },
        {
            "metadata": {},
            "execution_count": 19
        }
    ]
},
{
    "cell_type": "markdown",
    "source": [
        "One Hot encoding"
    ],
    "metadata": {
        "id": "t15cuClDhT7f"
    }
},
{
    "cell_type": "code",
    "source": [
        "number_of_classes = 10 \n",

```

```

\n",      "y_train = np_utils.to_categorical (y_train, number_of_classes)

    "y_test = np_utils.to_categorical (y_test, number_of_classes)"
  ],
  "metadata": {
    "id": "g80zefzQhRC_"
  },
  "execution_count": 20,
  "outputs": []
},
{
  "cell_type": "markdown",
  "source": [
    "Add Layers"
  ],
  "metadata": {
    "id": "OsutO52qhctz"
  }
},
{
  "cell_type": "code",
  "source": [
    "model=Sequential ()\n", "\n",
    "model.add(Conv2D(64, (3, 3), input_shape=(28, 28, 1),
activation='relu'))\n",
    "model.add(Conv2D(32, (3, 3), activation = 'relu'))\n", "\n",
    "model.add(Flatten())\n", "model.add(Dense(number_of_classes,activation =
'softmax'))"
  ],
  "metadata": {
    "id": "MwvV0HK4c6Oc"
  },
  "execution_count": 23,
  "outputs": []
},
{
  "cell_type": "markdown",
  "source": [
    "Compile model"
  ],
  "metadata": {
    "id": "BVSVSKuVhrHa"
  }
},
{
  "cell_type": "code",
  "source": [
    "model.compile(loss='categorical_crossentropy',
optimizer='Adam', metrics=['accuracy'])"
  ],
  "metadata": {
    "id": "xdk6eEbTdIMJ"
  },
  "execution_count": 24,
  "outputs": []
},

```

```

{
  "cell_type": "code",
  "source": [
    "x_train = np.asarray(x_train)\n", "y_train =\n",
    np.asarray(y_train)"
  ],
  "metadata": {
    "id": "trnT3hvr dLPQ"
  },
  "execution_count": 8,
  "outputs": []
},
{
  "cell_type": "markdown",
  "source": [
    "Model training"
  ],
  "metadata": {
    "id": "ValD_GsrhyQq"
  }
},
{
  "cell_type": "code",
  "source": [
    "model.fit(x_train, y_train, validation_data=(x_test, y_test),\n",
    epochs=5, batch_size=32)"
  ],
  "metadata": {
    "colab": {
      "base_uri": "https://localhost:8080/"
    },
    "id": "2gWsqfxndORJ",
    "outputId": "77d7dce4-838f-490c-bd6a-d3fb4efb0b2d"
  },
  "execution_count": 25,
  "outputs": [
    {
      "output_type": "stream",
      "name": "stdout", "text": [
        "Epoch 1/5\n",
        "1875/1875 [=====] - 124s 66ms/step\n",
        "- loss: 0.2126 - accuracy: 0.9534 - val_loss: 0.0857 - val_accuracy:0.9727\n",
        "Epoch 2/5\n",
        "1875/1875 [=====] - 122s 65ms/step\n",
        "- loss: 0.0633 - accuracy: 0.9806 - val_loss: 0.0812 - val_accuracy:0.9751\n",
        "Epoch 3/5\n",
        "1875/1875 [=====] - 121s 65ms/step\n",
        "- loss: 0.0451 - accuracy: 0.9863 - val_loss: 0.0776 - val_accuracy:0.9780\n",
        "Epoch 4/5\n",
        "1875/1875 [=====] - 122s 65ms/step\n",
        "- loss: 0.0313 - accuracy: 0.9905 - val_loss: 0.1089 - val_accuracy:0.9736\n",
        "Epoch 5/5\n",

```

```
        "1875/1875 [=====] - 121s 65ms/step\n",
        "- loss: 0.0277 - accuracy: 0.9917 - val_loss: 0.0893 - val_accuracy:0.9779\n"
    ]
},
{
    "output_type": "execute_result", "data": {
        "text/plain": [
            "<keras.callbacks.History at 0x7fd48aca7a10>"
        ]
    },
    "metadata": {},
    "execution_count": 25
}
]
},
{
    "cell_type": "markdown",
    "source": [
        "Evaluating the model for Accuracy"
    ],
    "metadata": {
        "id": "p6gQCBuQh4jY"
    }
},
{
    "cell_type": "code",
    "source": [
        "metrics = model.evaluate(x_test, y_test, verbose=0)\n", "print(\"Metrics\n",
        "[Test loss, Test Accuracy] : \")\n", "print(metrics)"
    ],
    "metadata": {
        "colab": {
            "base_uri": "https://localhost:8080/"
        },
        "id": "4FfWxiILf6pJ",
        "outputId": "30f49618-7fb5-4095-bf9d-bba4df94fd70"
    },
    "execution_count": 26,
    "outputs": [
        {
            "output_type": "stream",
            "name": "stdout", "text": [
                "Metrics [Test loss, Test Accuracy] : \n", "[0.0893181562423706,\n",
                "0.9779000282287598]\n"
            ]
        }
    ]
},
{
    "cell_type": "markdown",
    "source": [
        "Prediction"
    ],
    "metadata": {

```

```

        "id": "7E7b6lcHiJBj"
    }
},
{
    "cell_type": "code",
    "source": [
        "prediction=model.predict(x_test[6000:6001])\n", "print(prediction)"
    ],
    "metadata": {
        "colab": {
            "base_uri": "https://localhost:8080/"
        },
        "id": "zMM6L4syf_lv",
        "outputId": "ea4d0d08-f87e-4e96-e7f7-57b713439c25"
    },
    "execution_count": 13,
    "outputs": [
        {
            "output_type": "stream",
            "name": "stdout", "text": [
                "1/1 [=====] - 0s 15ms/step\n",
                "[[3.3381129e-13 1.0344202e-18 2.4497482e-11 1.6618515e-09\n",
                1.0295421e-06\n",
                "2.3502807e-11 6.7067222e-20 1.2130131e-07 2.3948130e-07\n",
                9.9999857e-01]]\n"
            ]
        }
    ]
},
{
    "cell_type": "code",
    "source": [
        "import numpy as np\n", "print(np.argmax(prediction,\n",
        axis=1))"
    ],
    "metadata": {
        "colab": {
            "base_uri": "https://localhost:8080/"
        },
        "id": "2K0liO_AgQBP",
        "outputId": "c08bdee9-2e68-4353-9ece-87d4f1ba9d56"
    },
    "execution_count": 16,
    "outputs": [
        {
            "output_type": "stream",
            "name": "stdout", "text": [
                "[9]\n"
            ]
        }
    ]
},
{
    "cell_type": "code",
    "source": [

```

```

        "np.argmax(y_test[6000:6001])"
    ],
    "metadata": {
        "colab": {
            "base_uri": "https://localhost:8080/"
        },
        "id": "58Es--w_gTqH",
        "outputId": "02fc04d1-9226-49df-f7d3-0ced3da371fb"
    },
    "execution_count": 17,
    "outputs": [
        {
            "output_type": "execute_result", "data": {
                "text/plain": ["9"]
            },
            "metadata": {},
            "execution_count": 17
        }
    ]
},
{
    "cell_type": "markdown",
    "source": [
        "Save the model"
    ],
    "metadata": {
        "id": "d4OryNZ9iOQT"
    }
},
{
    "cell_type": "code",
    "source": [
        "model.save('models/mnistDatasetmodel.h5')"
    ],
    "metadata": {
        "id": "9kmgteYgZJQ"
    },
    "execution_count": 28,
    "outputs": []
}
]
}

```