

# **EDGE INTELLIGENCE**

## **ASSIGNMENT - 2**

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## TASK 1:

In this task, the MNIST handwritten digit dataset is analyzed and basic preprocessing techniques such as normalization and reshaping are applied. An Artificial Neural Network (ANN) is used to perform digit classification and the model is trained and evaluated for accuracy. Finally, the trained model is saved using the pickle format for reuse.

```
[10] 2s ① import tensorflow as tf
from tensorflow import keras
import numpy as np
import matplotlib.pyplot as plt

# =====
# JAR 1: DATA JAR
# =====
# Loading and inspecting the MNIST dataset
(x_train, y_train), (x_test, y_test) = keras.datasets.mnist.load_data()

print("x_train dtype:", x_train.dtype)
print("x_train min/max:", x_train.min(), x_train.max())
print("x_train shape:", x_train.shape)
print("x_test shape:", x_test.shape)

# =====
# JAR 2: TASK JAR
# =====
# Task: Digit Classification (0-9)
# Data preprocessing for the task

# Normalize pixel values to range 0-1
x_train = x_train / 255.0
x_test = x_test / 255.0

# Reshape input data to match neural network expectations
x_train = x_train.reshape(-1, 28, 28 ,1)
x_test = x_test.reshape(-1, 28, 28 ,1)
```

```
[10] 2s ② # =====
# JAR 3: MODEL JAR
# =====
# Artificial Neural Network (ANN) architecture definition

model = keras.Sequential([
    keras.layers.Flatten(input_shape=(28, 28)),      # Feature flattening
    keras.layers.Dense(128, activation='relu'),        # Hidden layer
    keras.layers.Dense(10, activation='softmax')       # Output layer (10 classes)
])

# =====
# JAR 4: LOSS JAR
# =====
# Defining loss function and optimization strategy

model.compile(
    optimizer='sgd',                                # Optimization algorithm
    loss='sparse_categorical_crossentropy',          # Loss function
    metrics=['accuracy']                            # Performance metric
)

# =====
# JAR 5: LEARNING JAR
# =====
# Model learning through training

history=model.fit(x_train, y_train, epochs=5, batch_size=64)
```

```

# =====
# JAR 6: ACCURACY JAR
# =====
# Model evaluation and performance measurement

loss, acc = model.evaluate(x_test, y_test, verbose=0)
print("Test Loss:", loss)
print("Test Accuracy:", acc)

for i, acc in enumerate(history.history['accuracy']):
    print(f"Epoch {i+1} Training Accuracy: {acc:.4f}")

# Predictions to verify learned knowledge
pred_probs = model.predict(x_test[:5])
pred_labels = np.argmax(pred_probs, axis=1)

print("Predicted:", pred_labels)
print("Actual:   ", y_test[:5])

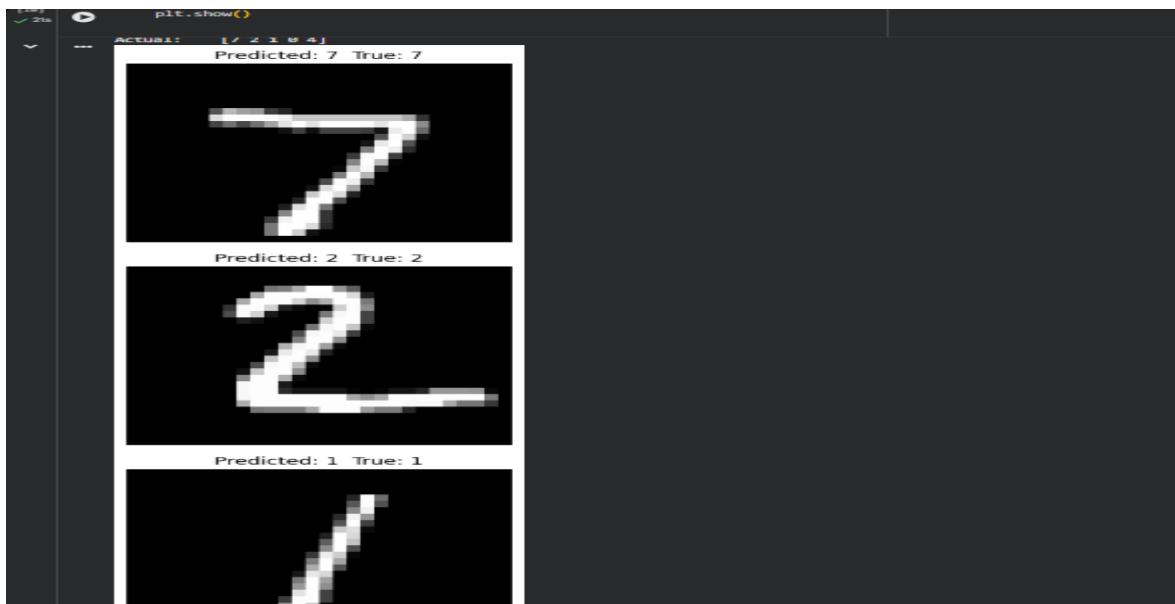
# Visual verification of predictions
for i in range(5):
    plt.figure(figsize=(4, 4))
    plt.imshow(x_test[i], cmap="gray")
    plt.title(f"Predicted: {pred_labels[i]} True: {y_test[i]}")
    plt.axis("off")
    plt.show()

```

```

[18] 21s
...
*** x_train dtype: uint8
x_train min/max: 0 255
x_train shape: (60000, 28, 28)
x_test shape: (10000, 28, 28)
/usr/local/lib/python3.12/dist-packages/keras/src/layers/reshaping/flatten.py:37: UserWarning: Do not pass an 'input_shape'/'input_dim' argument to a layer. When using Sequential models, prefer u
super().__init__(**kwargs)
Epoch 1/5
938/938      4s 4ms/step - accuracy: 0.6691 - loss: 1.2674
Epoch 2/5
938/938      3s 3ms/step - accuracy: 0.8869 - loss: 0.4291
Epoch 3/5
938/938      5s 5ms/step - accuracy: 0.9027 - loss: 0.3552
Epoch 4/5
938/938      4s 3ms/step - accuracy: 0.9097 - loss: 0.3227
Epoch 5/5
938/938      3s 4ms/step - accuracy: 0.9187 - loss: 0.2926
WARNING:tensorflow:6 out of the last 6 calls to <function TensorFlowTrainer.make_predict_function.<locals>.one_step_on_data_distributed at 0x79174adb440> triggered tf.function retracing. Tracing
Test Loss: 0.2771227109432205
Test Accuracy: 0.9229000210762824
Epoch 1 Training Accuracy: 0.797/
Epoch 2 Training Accuracy: 0.8896
Epoch 3 Training Accuracy: 0.9036
Epoch 4 Training Accuracy: 0.9118
Epoch 5 Training Accuracy: 0.9182
1/1           0s 79ms/step
Predicted: [7 2 1 0 4]
Actual:     [7 2 1 0 4]
Predicted: 7 True: 7


```



```
[11] ✓ 0s
import pickle

# Save model using pickle
with open("mnist_ann_model.pkl", "wb") as file:
    pickle.dump(model, file)

print("Model saved successfully in pickle format")

Model saved successfully in pickle format

[12] ✓ 1s
▶ import pickle

with open("mnist_ann_model.pkl", "rb") as file:
    loaded_model = pickle.load(file)

# Test loaded model
loss, acc = loaded_model.evaluate(x_test, y_test, verbose=0)
print("Loaded Model Accuracy:", acc)

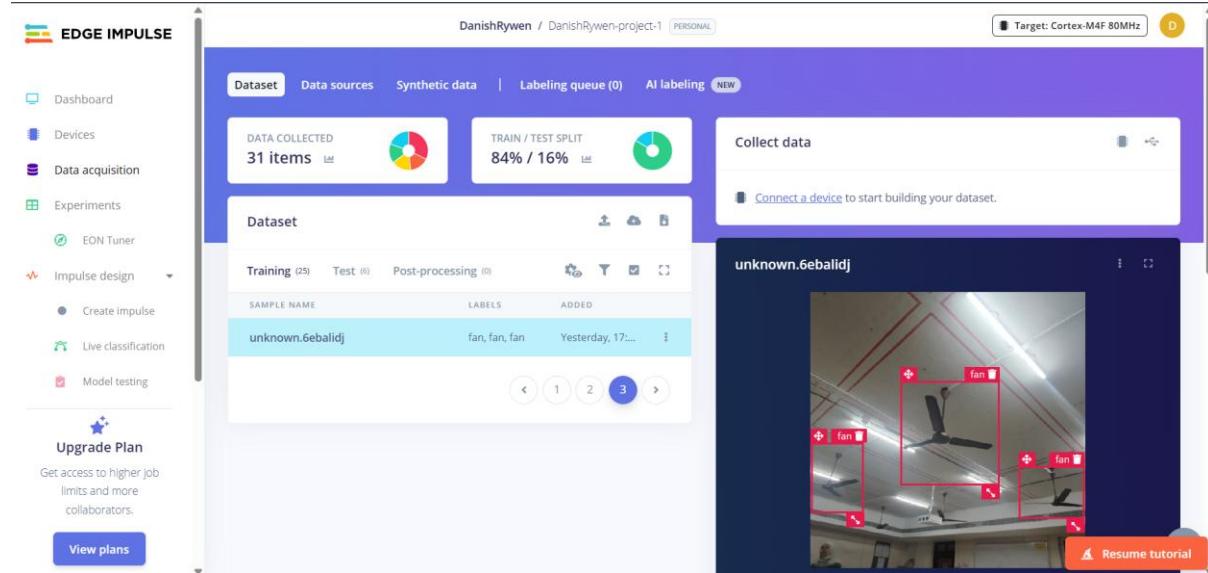
... Loaded Model Accuracy: 0.9229000210762024
```

The screenshot shows the Colab interface with the following details:

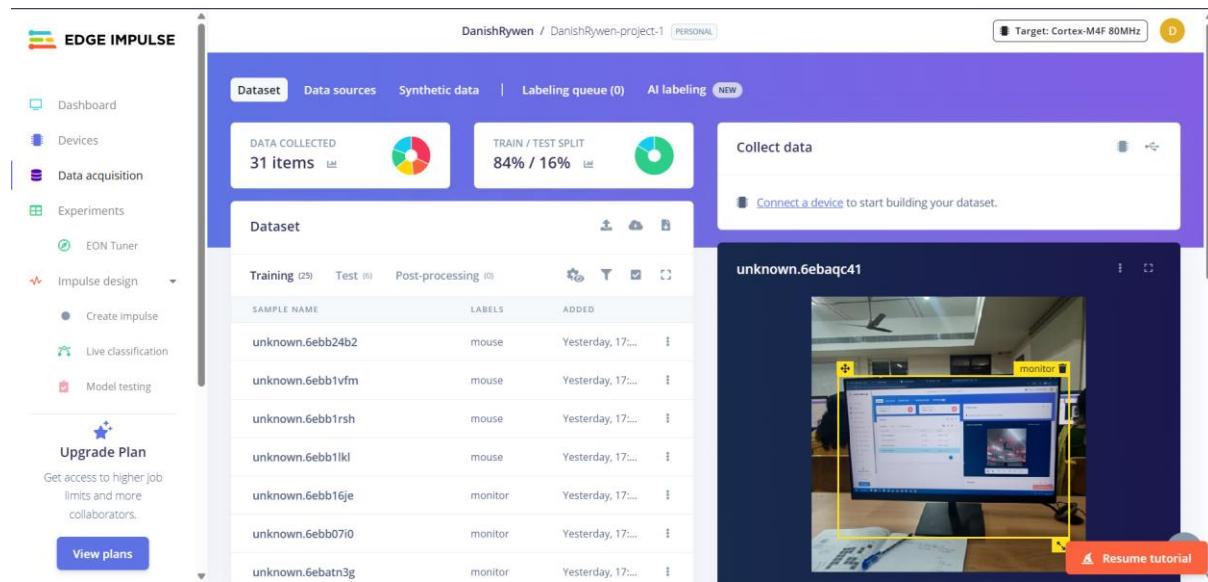
- File Explorer (Left):** Shows a directory structure with a file named `mnist_ann_model.pkl` selected. The file is 417.62K and was last modified on Fri Jan 09 2026 21:13:20 GMT+0530 (India Standard Time).
- Code Editor (Bottom):** Displays two code cells. Cell [11] contains code to save a model to a pickle file, and Cell [12] contains code to load the model and print its accuracy.
- Output Area (Top Right):** Shows the output of the code execution, including the message "Model saved successfully in pickle format" from Cell [11] and the loaded model's accuracy from Cell [12].

## TASK 2:

An account is created on the Edge Impulse platform and the data acquisition section is accessed. Image data is collected by connecting a mobile device via QR code and labeling the data. The collected dataset is then organized and split into training and testing sets for further model development.



The screenshot shows the Edge Impulse platform interface. On the left, a sidebar menu includes options like Dashboard, Devices, Data acquisition, Experiments, EON Tuner, Impulse design (with Create impulse, Live classification, and Model testing), and an Upgrade Plan section. The main area displays a dataset titled "DanishRywen / DanishRywen-project-1". It shows "DATA COLLECTED 31 items" and a "TRAIN / TEST SPLIT 84% / 16%". A "Dataset" table lists entries such as "unknown.6ebalidj" with labels "fan, fan, fan" and timestamp "Yesterday, 17:...". Below the table are navigation arrows. To the right, a "Collect data" section prompts to "Connect a device to start building your dataset". A preview image titled "unknown.6ebalidj" shows multiple ceiling fans with red bounding boxes and "fan" labels. A "Resume tutorial" button is at the bottom right.



This screenshot shows the same Edge Impulse platform interface as the previous one, but with a different dataset. The main area displays a dataset titled "DanishRywen / DanishRywen-project-1". It shows "DATA COLLECTED 31 items" and a "TRAIN / TEST SPLIT 84% / 16%". A "Dataset" table lists entries such as "unknown.6ebb24b2" with labels "mouse" and timestamp "Yesterday, 17:...", and "unknown.6ebb1vfm" with labels "mouse" and timestamp "Yesterday, 17:...". Other entries include "monitor" labels for various items. Below the table are navigation arrows. To the right, a "Collect data" section prompts to "Connect a device to start building your dataset". A preview image titled "unknown.6ebaqc41" shows a computer monitor displaying the Edge Impulse app interface with a yellow bounding box around it, and a "monitor" label nearby. A "Resume tutorial" button is at the bottom right.

**EDGE IMPULSE**

Dashboard Devices Data acquisition Experiments EON Tuner Impulse design Create impulse Live classification Model testing

**Upgrade Plan**  
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DanishRywen / DanishRywen-project-1 PERSONAL Target: Cortex-M4F 80MHz D

**Dataset** Data sources Synthetic data | Labeling queue (0) AI labeling NEW

**DATA COLLECTED**  
31 items TRAIN / TEST SPLIT 84% / 16%

**Dataset**

SAMPLE NAME	LABELS	ADDED
unknown.6ebb24b2	mouse	Yesterday, 17:...
unknown.6ebb1vfm	mouse	Yesterday, 17:...
unknown.6ebb1rsh	mouse	Yesterday, 17:...
unknown.6ebb1lkl	mouse	Yesterday, 17:...
unknown.6ebb16je	monitor	Yesterday, 17:...
unknown.6ebb07i0	monitor	Yesterday, 17:...
unknown.6ebatn3g	monitor	Yesterday, 17:...

**Collect data**

Connect a device to start building your dataset.

**unknown.6ebb16je**

[Resume tutorial](#)

**EDGE IMPULSE**

Dashboard Devices Data acquisition Experiments EON Tuner Impulse design Create impulse Live classification Model testing

**Upgrade Plan**  
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DanishRywen / DanishRywen-project-1 PERSONAL Target: Cortex-M4F 80MHz D

**Dataset** Data sources Synthetic data | Labeling queue (0) AI labeling NEW

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**Dataset**

SAMPLE NAME	LABELS	ADDED
unknown.6ebb24b2	mouse	Yesterday, 17:...
unknown.6ebb1vfm	mouse	Yesterday, 17:...
unknown.6ebb1rsh	mouse	Yesterday, 17:...
unknown.6ebb1lkl	mouse	Yesterday, 17:...
unknown.6ebb16je	monitor	Yesterday, 17:...
unknown.6ebb07i0	monitor	Yesterday, 17:...
unknown.6ebatn3g	monitor	Yesterday, 17:...

**Collect data**

Connect a device to start building your dataset.

**unknown.6ebb1lkl**

[Resume tutorial](#)

EDGE IMPULSE

DanishRywen / DanishRywen-project-1 PERSONAL

Target: Cortex-M4F 80MHz D

Dataset Data sources Synthetic data | Labeling queue (0) AI labeling NEW

DATA COLLECTED 31 items TRAIN / TEST SPLIT 84% / 16%

Collect data

Connect a device to start building your dataset.

Dataset

Training (25) Test (6) Post-processing (0)

SAMPLE NAME	LABELS	ADDED
unknown.6ebb24b2	mouse	Yesterday, 17:...
unknown.6ebb1vfm	mouse	Yesterday, 17:...
unknown.6ebb1rsh	mouse	Yesterday, 17:...
unknown.6ebb1lk1	mouse	Yesterday, 17:...
unknown.6ebb16je	monitor	Yesterday, 17:...
unknown.6ebb07i0	monitor	Yesterday, 17:...
unknown.6ebatn3g	monitor	Yesterday, 17:...

unknown.6ebb1rsh

Resume tutorial

Dataset

Training (25) Test (6) Post-processing (0)

SAMPLE NAME	LABELS	ADDED
unknown.6ebbiq8	mobile	Yesterday, 17:...
unknown.6ebbl0ib	mobile	Yesterday, 17:...
unknown.6ebbg3qh	mobile	Yesterday, 17:...
unknown.6ebbf715	mobile	Yesterday, 17:...
unknown.6ebbeact	mobile	Yesterday, 17:...
unknown.6ebbb8t5e	pen	Yesterday, 17:...
unknown.6ebb8mtf	pen	Yesterday, 17:...

unknown.6ebb4uh1

Resume tutorial

EDGE IMPULSE

DanishRywen / DanishRywen-project-1 PERSONAL

Target: Cortex-M4F 80MHz D

Dataset Data sources Synthetic data | Labeling queue (0) AI labeling NEW

DATA COLLECTED 31 items TRAIN / TEST SPLIT 84% / 16%

Collect data

Connect a device to start building your dataset.

Dataset

Training (25) Test (6) Post-processing (0)

SAMPLE NAME	LABELS	ADDED
unknown.6ebbiq8	mobile	Yesterday, 17:...
unknown.6ebbl0ib	mobile	Yesterday, 17:...
unknown.6ebbg3qh	mobile	Yesterday, 17:...
unknown.6ebbf715	mobile	Yesterday, 17:...
unknown.6ebbeact	mobile	Yesterday, 17:...
unknown.6ebbb8t5e	pen	Yesterday, 17:...
unknown.6ebb8mtf	pen	Yesterday, 17:...

unknown.6ebb4uh1

Resume tutorial

**EDGE IMPULSE**

DanishRywen / DanishRywen-project-1 PERSONAL Target: Cortex-M4F 80MHz D

**Dataset** Data sources Synthetic data | Labeling queue (0) AI labeling NEW

**DATA COLLECTED**  
31 items 

**Collect data**  
Connect a device to start building your dataset.

**Dataset**

Training (25) Test (6) Post-processing (0)

SAMPLE NAME	LABELS	ADDED
unknown.6ebbriq8	mobile	Yesterday, 17:...
unknown.6ebbl0ib	mobile	Yesterday, 17:...
unknown.6ebbg3qh	mobile	Yesterday, 17:...
unknown.6ebbf715	mobile	Yesterday, 17:...
unknown.6ebbeact	mobile	Yesterday, 17:...
unknown.6ebb8t5e	pen	Yesterday, 17:...
unknown.6ebb8mtf	pen	Yesterday, 17:...

**unknown.6ebb8t5e**



Resume tutorial

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**EDGE IMPULSE**

DanishRywen / DanishRywen-project-1 PERSONAL Target: Cortex-M4F 80MHz D

**Dataset** Data sources Synthetic data | Labeling queue (0) AI labeling NEW

**See the data distribution breakdown for labels in the training category**

**DATA COLLECTED**  
31 items 

**Collect data**  
Connect a device to start building your dataset.

**Dataset**

Training (25) Test (6) Post-processing (0)

SAMPLE NAME	LABELS	ADDED
unknown.6ebbriq8	mobile	Yesterday, 17:...
unknown.6ebbl0ib	mobile	Yesterday, 17:...
unknown.6ebbg3qh	mobile	Yesterday, 17:...
unknown.6ebbf715	mobile	Yesterday, 17:...
unknown.6ebbeact	mobile	Yesterday, 17:...
unknown.6ebb8t5e	pen	Yesterday, 17:...
unknown.6ebb8mtf	pen	Yesterday, 17:...

**unknown.6ebbeact**



Resume tutorial

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