EDGE INTELLIGENCE ASSIGNMENT - 2

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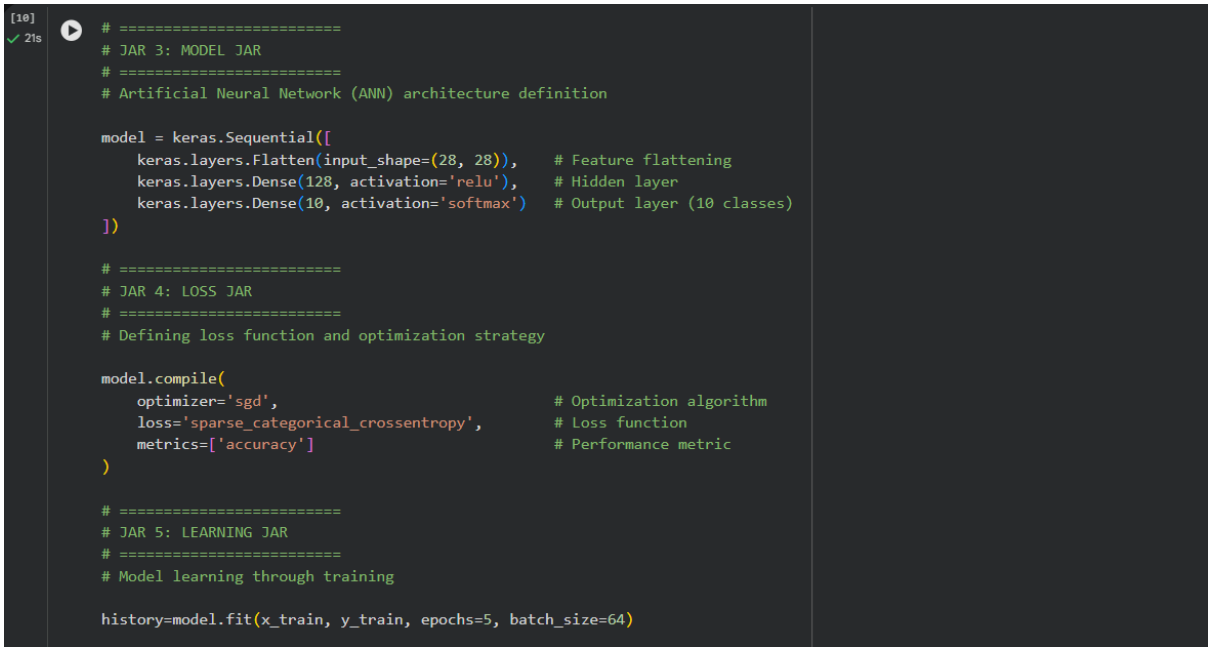
TASK 1:

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.

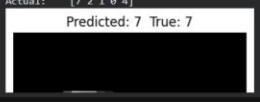
```
[10]
✓ 21s
import tensorflow as tf
from tensorflow import keras
import numpy as np
import matplotlib.pyplot as plt

# ========================
# 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)
```



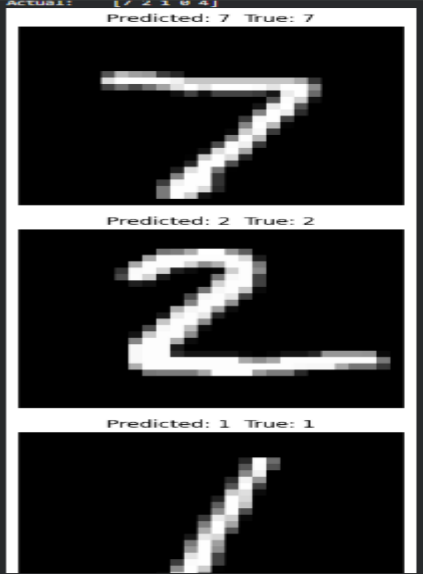
```
[10]
✓ 21s
# ========================
# JAR 3: MODEL JAR
# ========================
# Artificial Neural Network (ANN) architecture definition

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)
```

```python
# ========================
# 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()
```

```
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 0x79174adb4400> triggered tf.function retracing. Tracing
Test Loss: 0.27212271094322205
Test Accuracy: 0.9229000210762024
Epoch 1 Training Accuracy: 0.7977
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]
```




```
plt.show()
Actual:    [7 2 1 0 4]
```



[11] ✓ 0s

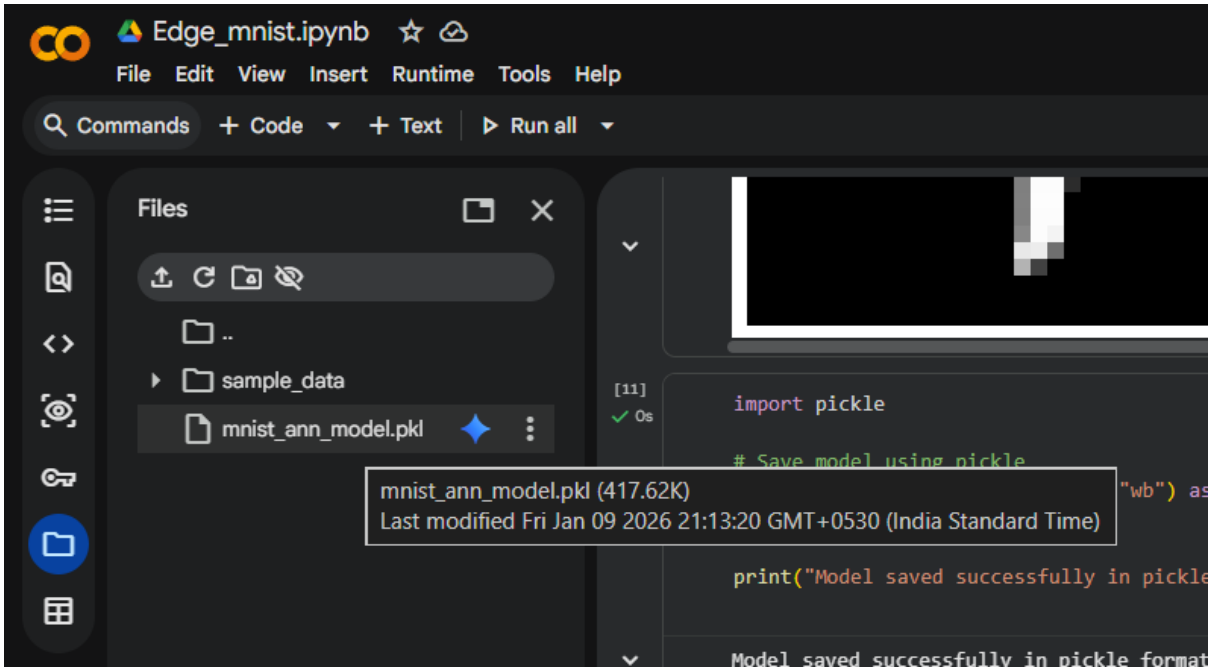
```
import pickle

# 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

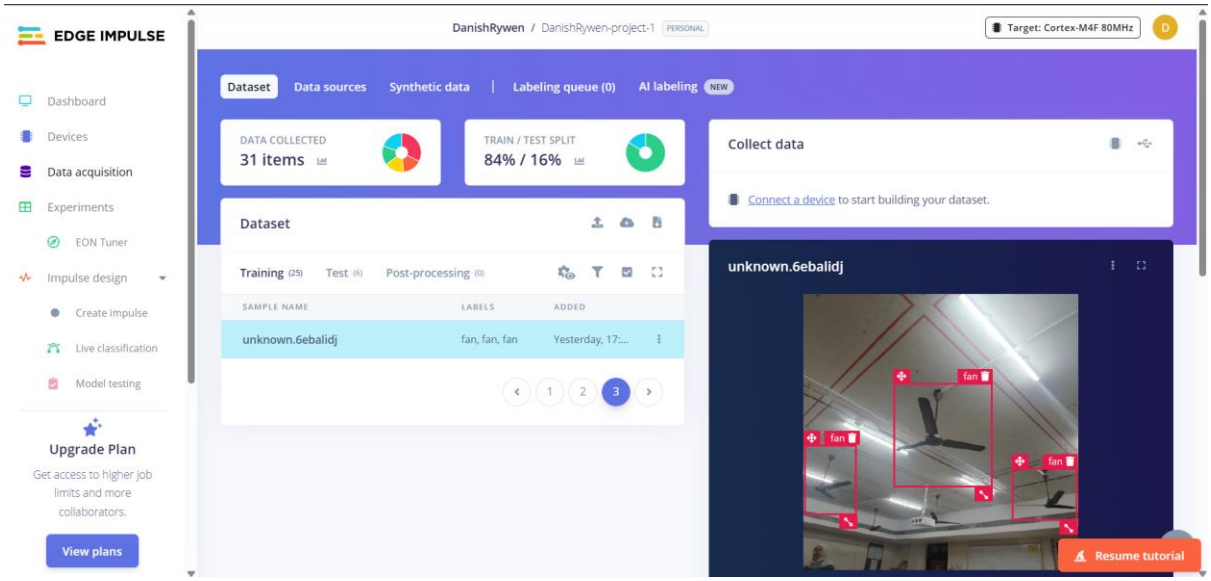
```
import pickle

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)
```

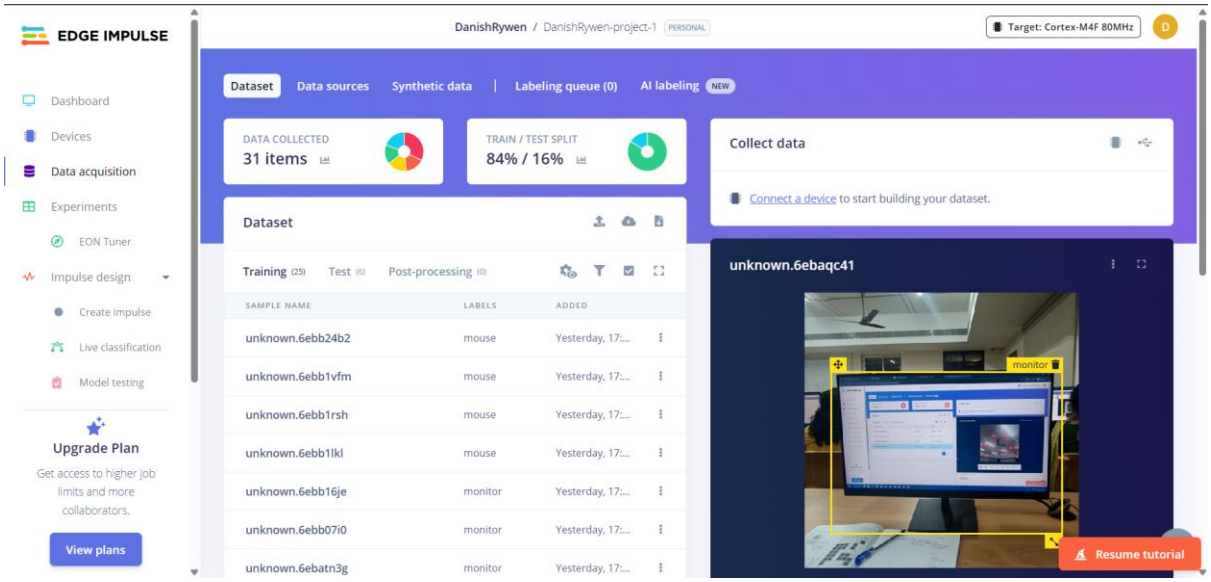
```
Loaded Model Accuracy: 0.9229000210762024
```

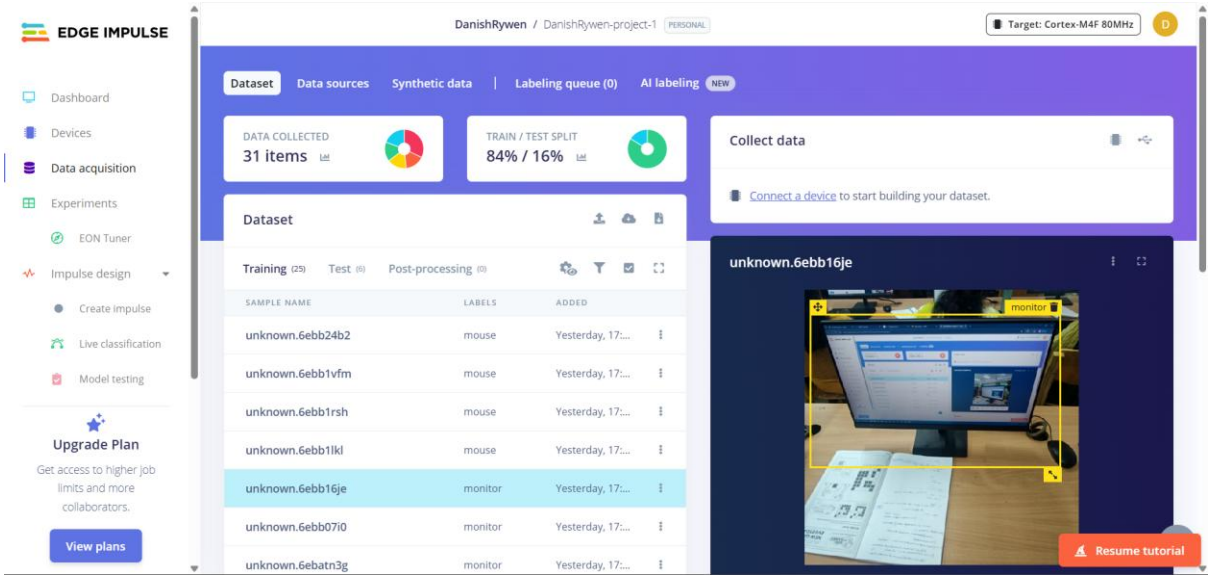


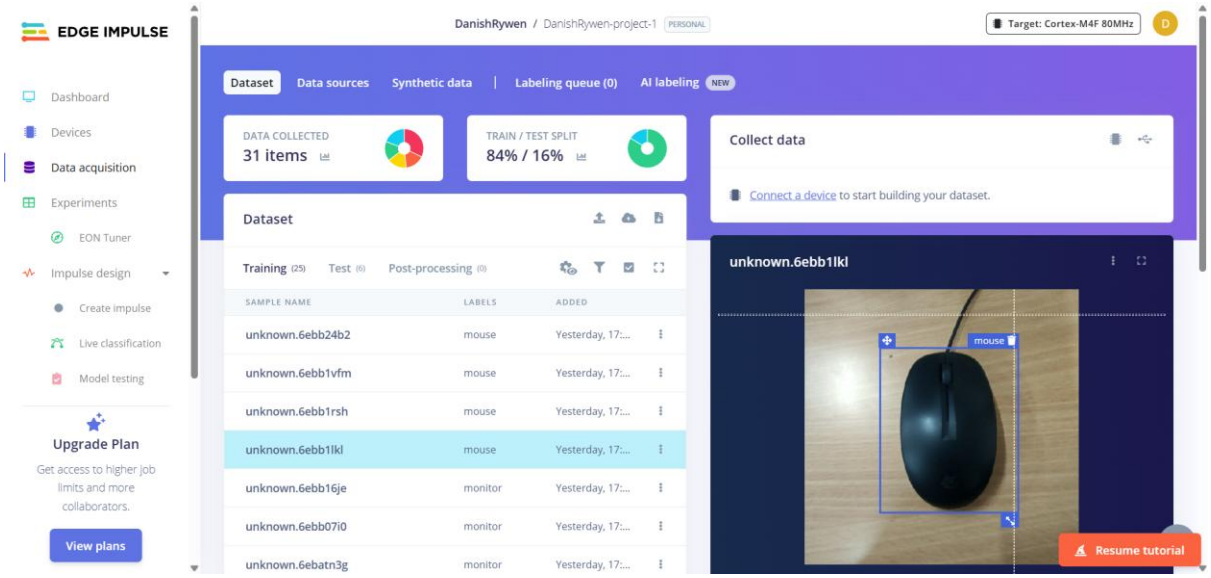
TASK 2:

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.






EDGE IMPULSE
DanishRywen / DanishRywen-project-1
PERSONAL
Target: Cortex-M4F 80MHz
Dashboard
Devices
Data acquisition
Experiments
EON Tuner
Impulse design
Create impulse
Live classification
Model testing
Upgrade Plan
Get access to higher job limits and more collaborators.
View plans
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.6ebb1lkl mouse Yesterday, 17:...
unknown.6ebb16je monitor Yesterday, 17:...
unknown.6ebb07i0 monitor Yesterday, 17:...
unknown.6ebatn3g monitor Yesterday, 17:...
unknown.6ebb16je
monitor
Resume tutorial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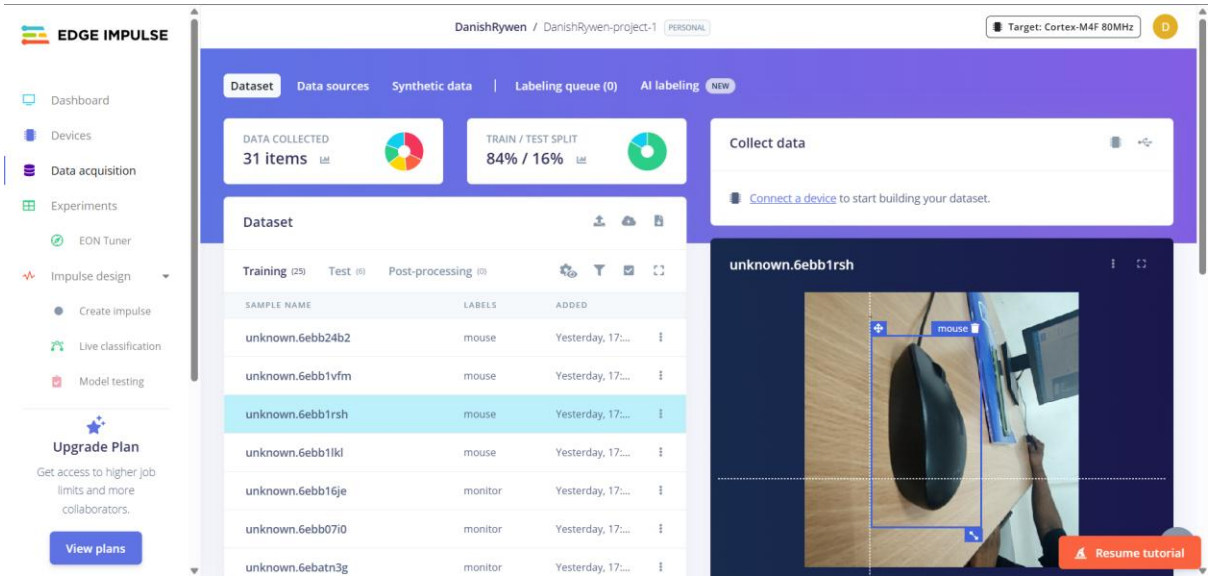
unknown.6ebatn3g monitor Yesterday, 17:...
unknown.6ebb1lkl
mouse
Resume tutorial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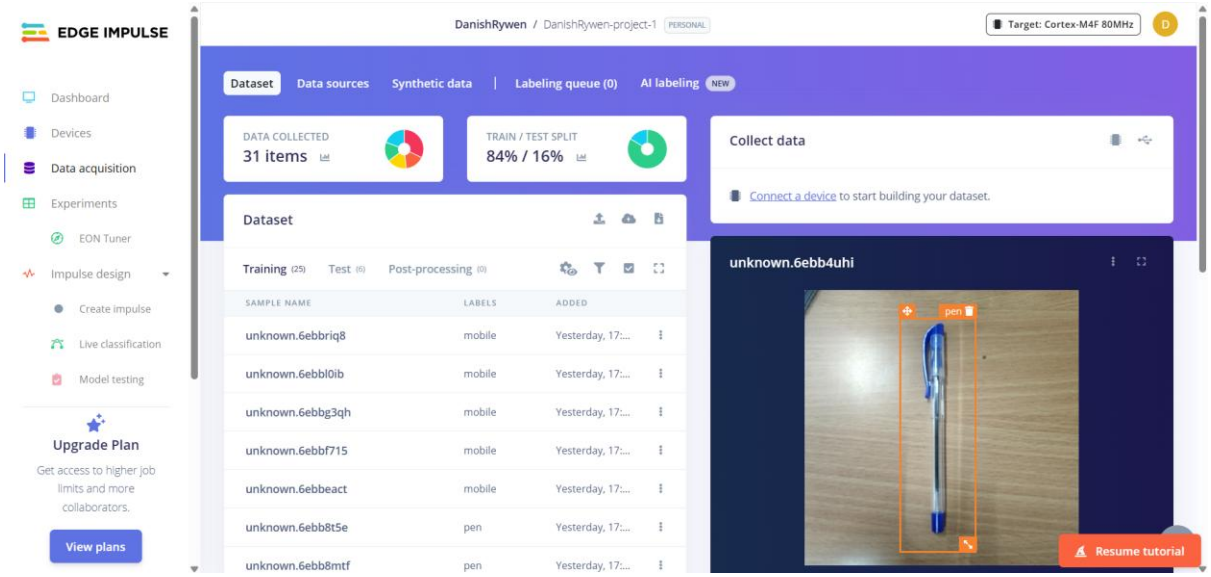
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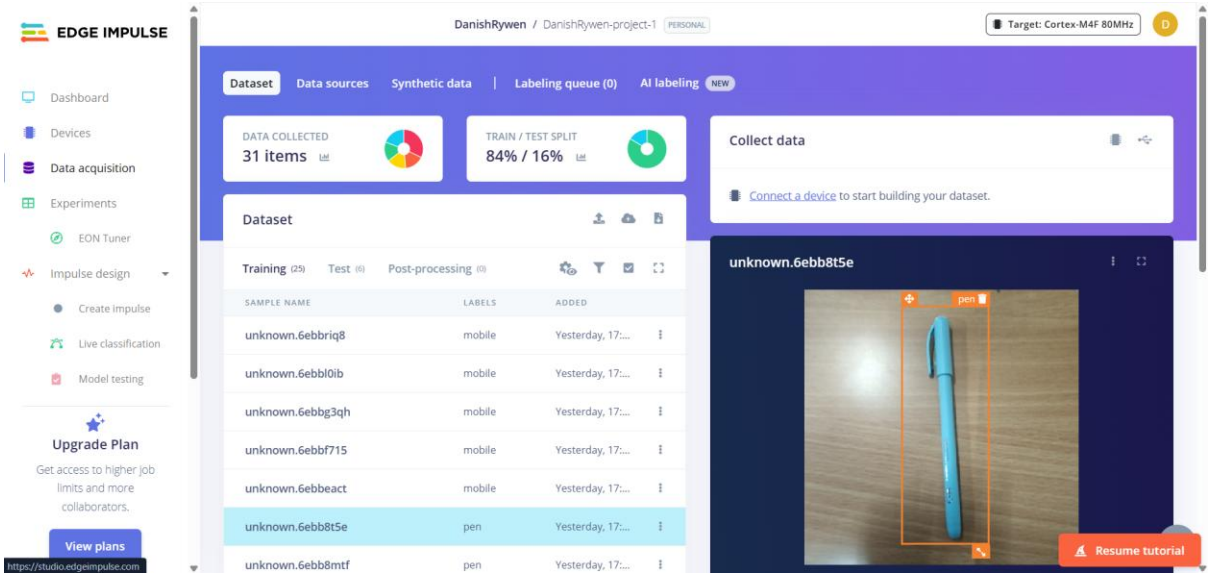
unknown.6ebbriq8 mobile Yesterday, 17:...
unknown.6ebbl0ib mobile Yesterday, 17:...
unknown.6ebbg3qh mobile Yesterday, 17:...
unknown.6ebbf715 mobile Yesterday, 17:...
unknown.6ebbeact mobile Yesterday, 17:...
unknown.6ebb8t5e pen Yesterday, 17:...
unknown.6ebb8mtf pen Yesterday, 17:...
unknown.6ebb4uhi
pen
Resume tutorial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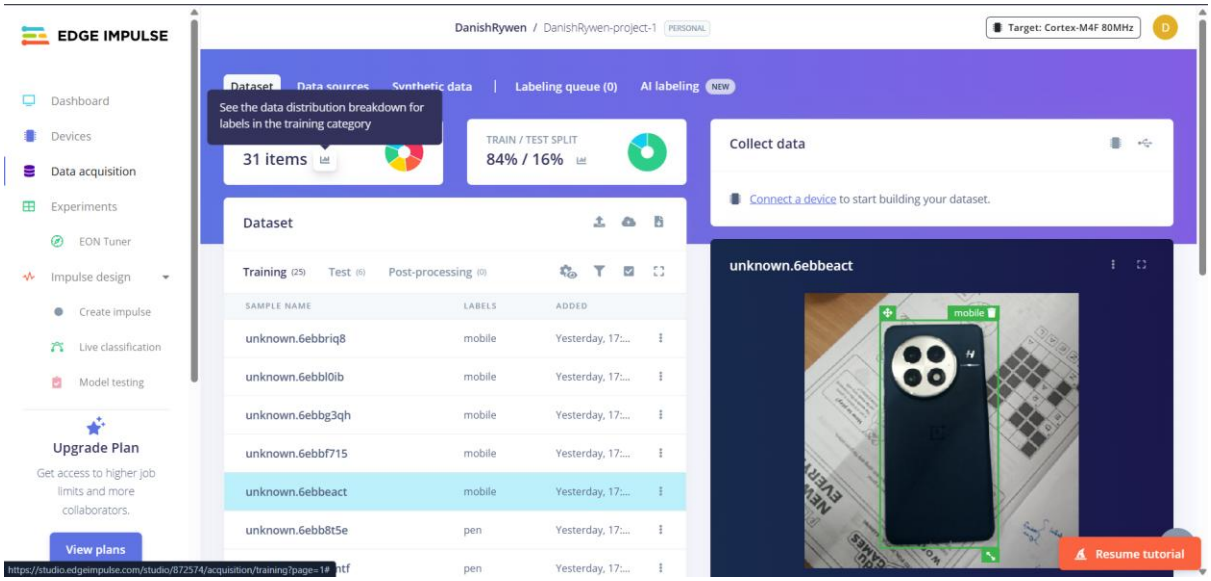
unknown.6ebbf715 mobile Yesterday, 17:...
unknown.6ebbeact mobile Yesterday, 17:...
unknown.6ebb8t5e pen Yesterday, 17:...
unknown.6ebb8mtf pen Yesterday, 17:...
unknown.6ebb8t5e
pen
Resume tutorial
https://studio.edgeimpulse.com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View plans
See the data distribution breakdown for labels in the training category
Dataset
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Synthetic data
Labeling queue (0)
AI labeling
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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
mobile
Resume tutorial
https://studio.edgeimpulse.com/studio/872574/acquisition/training?page=1#