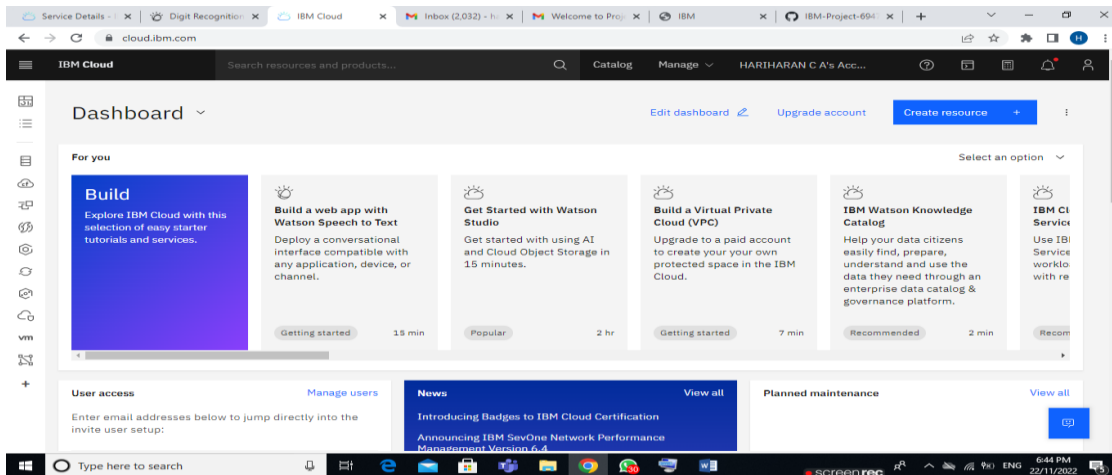


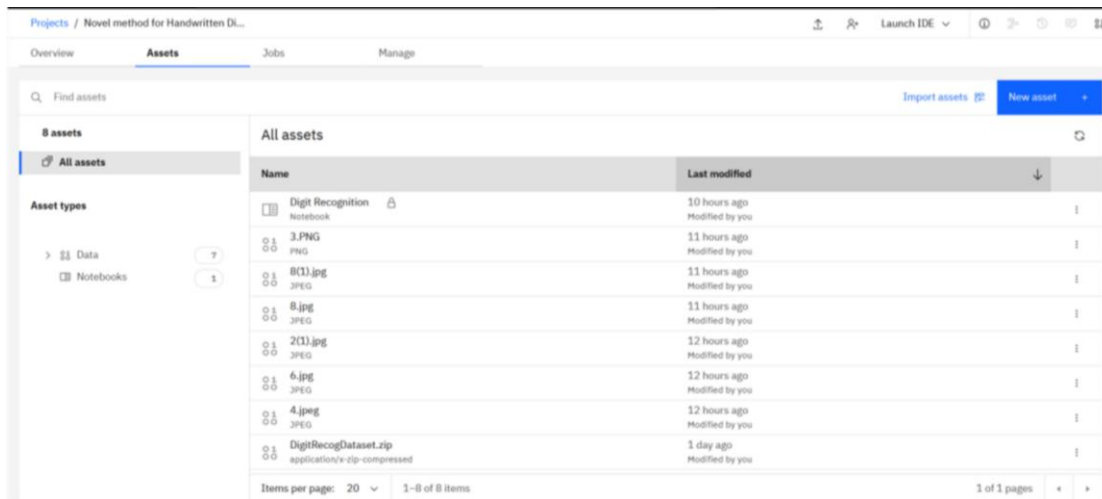
A Novel Method for Handwritten Digit Recognition

Team ID: PNT2022TMID35498

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```
X_train = X_train / 255.
X_test = X_test / 255.

X_train = X_train.astype(np.float32)
X_test = X_test.astype(np.float32)

input_shape = X_train[0].shape
```

Building a Model

```
In [8]: # Importing the required Keras modules containing model and layers
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Conv2D, Dropout, Flatten, MaxPooling2D
# Creating a Sequential Model and adding the layers
model = Sequential()
model.add(Conv2D(28, kernel_size=(3,3), input_shape=input_shape))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Flatten()) # Flattening the 2D arrays for fully connected layers
model.add(Dense(128, activation=tf.nn.relu))
model.add(Dropout(0.2))
model.add(Dense(10, activation=tf.nn.softmax))
```

Compile the Model

```
In [9]: model.compile(optimizer='adam',
                    loss='sparse_categorical_crossentropy',
                    metrics=['accuracy'])
```

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TRAINING THE MODEL:

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```
metrics=['accuracy'])
```

Fit the Model

```
In [10]: model.fit(x=X_train,y=y_train, epochs=10)

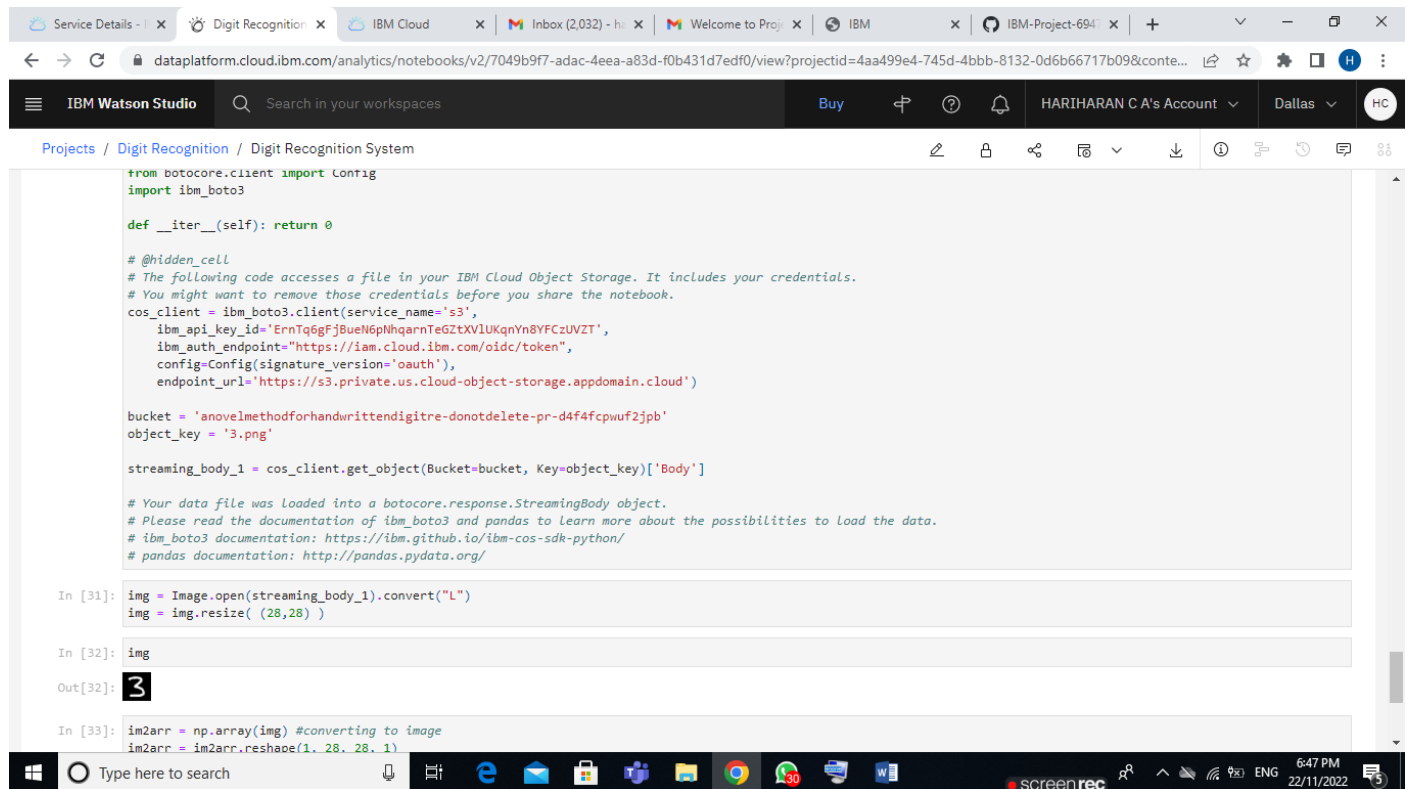
Epoch 1/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.2050 - accuracy: 0.9380
Epoch 2/10
1875/1875 [=====] - 43s 23ms/step - loss: 0.0838 - accuracy: 0.9745
Epoch 3/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.0591 - accuracy: 0.9815
Epoch 4/10
1875/1875 [=====] - 43s 23ms/step - loss: 0.0470 - accuracy: 0.9851
Epoch 5/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.0348 - accuracy: 0.98830s - loss: 0.0347 - accu
Epoch 6/10
1875/1875 [=====] - 43s 23ms/step - loss: 0.0290 - accuracy: 0.9900
Epoch 7/10
1875/1875 [=====] - 43s 23ms/step - loss: 0.0256 - accuracy: 0.9913
Epoch 8/10
1875/1875 [=====] - 43s 23ms/step - loss: 0.0234 - accuracy: 0.9922
Epoch 9/10
1875/1875 [=====] - 42s 23ms/step - loss: 0.0203 - accuracy: 0.9934
Epoch 10/10
1875/1875 [=====] - 41s 22ms/step - loss: 0.0192 - accuracy: 0.9937

Out[10]: <keras.callbacks.History at 0x7f2cee98a580>
```

Evaluate and predict the model

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Test Case:



The screenshot shows an IBM Watson Studio notebook titled 'Digit Recognition System'. The code in the notebook is as follows:

```
from boto3.client import Config
import boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
cos_client = boto3.client(service_name='s3',
    ibm_api_key_id='ErnTq6GfjBueN6pNhqarnTeG2tXVlUKqnYn8YFCzUVZT',
    ibm_auth_endpoint='https://iam.cloud.ibm.com/oidc/token',
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'anovelmethodforhandwrittendigitre-donotdelete-pr-d4f4cpwuf2jpb'
object_key = '3.png'

streaming_body_1 = cos_client.get_object(Bucket=bucket, Key=object_key)['Body']

# Your data file was loaded into a boto3.response.StreamingBody object.
# Please read the documentation of boto3 and pandas to learn more about the possibilities to load the data.
# boto3 documentation: https://boto3.amazonaws.com/v1/documentation/api/latest/guide/quickstart.html#authentication
# pandas documentation: http://pandas.pydata.org/

In [31]: img = Image.open(streaming_body_1).convert("L")
img = img.resize( (28,28) )

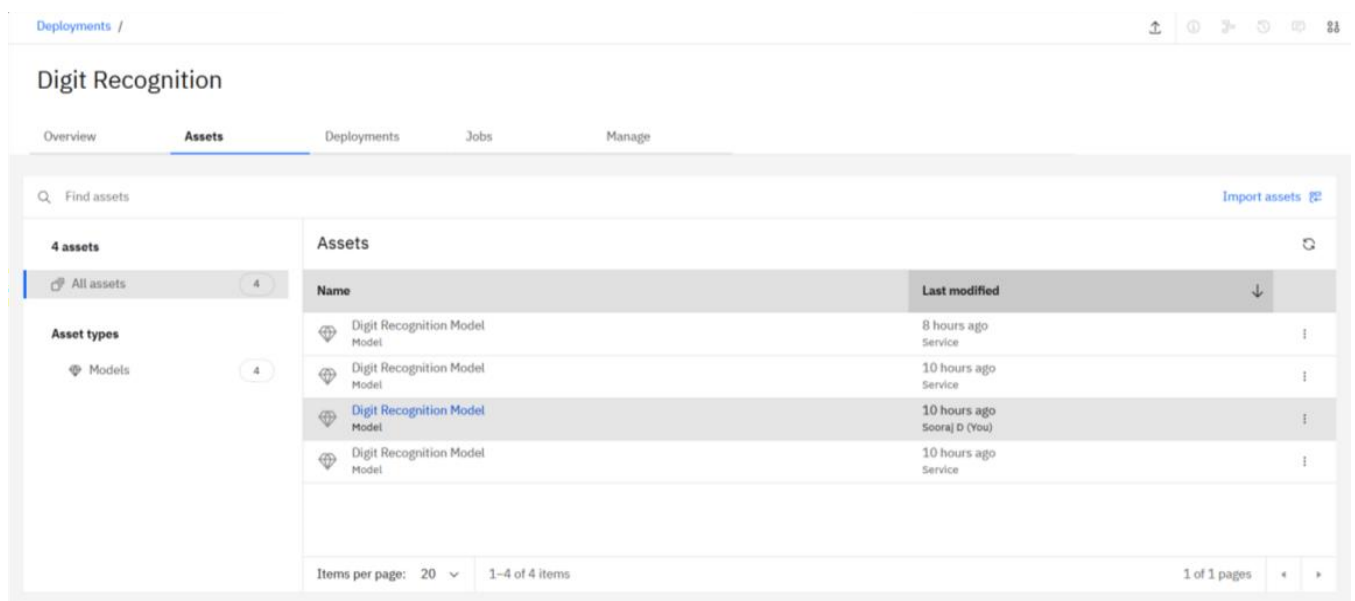
In [32]: img

Out[32]: 3

In [33]: im2arr = np.array(img) #converting to image
im2arr = im2arr.reshape(1, 28, 28, 1)
```

The notebook interface includes a top navigation bar with 'IBM Watson Studio' and a search bar. The bottom status bar shows the Windows taskbar with various application icons and the system clock indicating 6:47 PM on 22/11/2022.

IBM Deployment space:



The screenshot displays the 'Digit Recognition' deployment space in IBM Watson Studio. The 'Assets' tab is selected, showing a list of four assets. The left sidebar indicates there are 4 assets in total, with 4 models listed under 'Asset types'.

Name	Last modified
Digit Recognition Model	8 hours ago Service
Digit Recognition Model	10 hours ago Service
Digit Recognition Model	10 hours ago Sooraj D (You)
Digit Recognition Model	10 hours ago Service

At the bottom of the table, it shows 'Items per page: 20' and '1-4 of 4 items'. The page number '1 of 1 pages' is also displayed.