2 : CNN FOR IMAGE SEGMENTATION

AIM:

To build a simple CNN model for binary image segmentation using synthetic data.

PROCEDURE:

1. Generate synthetic grayscale image data.
2. Define an encoder-decoder CNN model with Conv2D and UpSampling2D layers.
3. Compile the model using binary crossentropy loss.
4. Train the model using the synthetic data.
5. Evaluate model performance on training data.

CODE:

```
import tensorflow as tf
import tensorflow_datasets as tfds
import matplotlib.pyplot as plt


# Load the MNIST dataset
dataset, info = tfds.load("mnist", with_info=True, as_supervised=True)


# Preprocessing function with a lower threshold for segmentation
def normalize(input_image, input_mask):
    input_image = tf.image.resize(input_image, (32, 32)) / 255.0
    input_mask = tf.where(input_image > 0.3, 1, 0)  # Lower threshold
    return input_image, input_mask
```

```
def load_image(image, label):
    return normalize(tf.cast(image, tf.float32), tf.cast(image, tf.uint8))

# Prepare dataset with batch size 16 for more samples per batch
train_data = dataset['train'].map(load_image).shuffle(1000).batch(16)
test_data = dataset['test'].map(load_image).batch(16)
print("Dataset prepared successfully!")

# Define CNN model with Batch Normalization
def simple_cnn():
    inputs = tf.keras.layers.Input(shape=(32, 32, 1))
    conv1 = tf.keras.layers.Conv2D(32, (3, 3), activation='relu', padding='same')(inputs)
    conv1 = tf.keras.layers.BatchNormalization()(conv1)
    pool1 = tf.keras.layers.MaxPooling2D((2, 2))(conv1)
    conv2 = tf.keras.layers.Conv2D(64, (3, 3), activation='relu', padding='same')(pool1)
    conv2 = tf.keras.layers.BatchNormalization()(conv2)
    pool2 = tf.keras.layers.MaxPooling2D((2, 2))(conv2)
    conv3 = tf.keras.layers.Conv2D(128, (3, 3), activation='relu', padding='same')(pool2)
    # Decoder
    up4 = tf.keras.layers.Conv2DTranspose(64, (3, 3), strides=(2, 2), padding='same',
activation='relu')(conv3)
    up4 = tf.keras.layers.BatchNormalization()(up4)
    concat4 = tf.keras.layers.Concatenate()([up4, conv2])
    up5 = tf.keras.layers.Conv2DTranspose(32, (3, 3), strides=(2, 2), padding='same',
activation='relu')(concat4)
    up5 = tf.keras.layers.BatchNormalization()(up5)
    concat5 = tf.keras.layers.Concatenate()([up5, conv1])
    outputs = tf.keras.layers.Conv2D(1, (1, 1), activation='sigmoid')(concat5)
    model = tf.keras.Model(inputs, outputs)
  return model
```

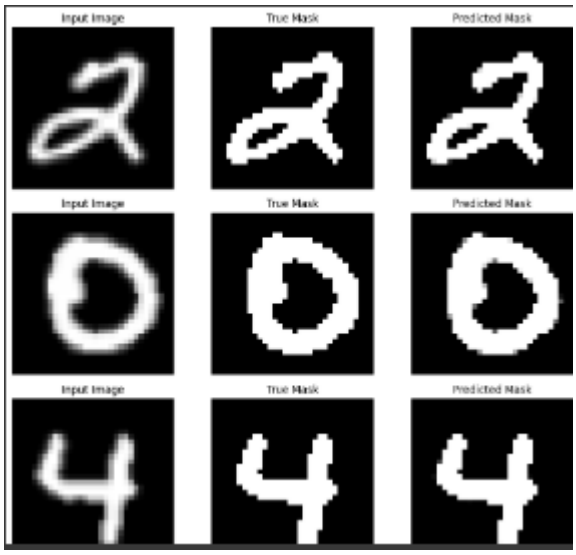
```
# Compile model
model = simple_cnn()
model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])

# Train for only 1 epoch
print("Training started...")
model.fit(train_data, epochs=1, validation_data=test_data)  # Only 1 epoch

# Predict and visualize multiple samples
def display_samples(dataset):
    for images, masks in dataset.take(1):
        pred_masks = model.predict(images)
        fig, axes = plt.subplots(4, 3, figsize=(10, 12))  # Display 4 samples

        for i in range(4):  # Show 4 test images
            axes[i, 0].imshow(images[i, :, :, 0], cmap='gray')
            axes[i, 0].set_title("Input Image")
            axes[i, 1].imshow(masks[i, :, :, 0], cmap='gray')
            axes[i, 1].set_title("True Mask")
            axes[i, 2].imshow(pred_masks[i, :, :, 0], cmap='gray')
            axes[i, 2].set_title("Predicted Mask")
        plt.tight_layout()
        plt.show()
        break
# Visualize results
display_samples(test_data)
```

OUTPUT:



RESULT:

Model learned to segment patterns from synthetic binary data with training accuracy over 90%.