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```
In [ ]: %matplotlib inline
import cv2
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import style
style.use('ggplot')
from IPython import display
import pandas as pd
import tensorflow as tf
```

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In [ ]: from google.colab import drive
drive.mount('/content/drive')
```

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In [ ]: !ls horses
```

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images masks
```

```
In [ ]: ## helper function for loading the horses data
#make sure the horses data is in the same directory as the notebook
#do not change this function
def load_horses_orig(path, image_size):
    mask_path = path + 'masks/'
    image_path = path + 'images/'
    images = []
    masks = []
    test_images = []
    test_masks = []
    for i in range(328):

        orig_im = cv2.imread(image_path + 'image-{}.png'.format(i))
        orig_im = cv2.cvtColor(orig_im, cv2.COLOR_RGB2BGR)

        low_im = cv2.resize(orig_im, dsize=(image_size, image_size))

        orig_mask = cv2.imread(mask_path + 'mask-{}.png'.format(i))
        low_mask = cv2.resize(orig_mask, dsize=(image_size, image_size))
        low_mask = cv2.cvtColor(low_mask, cv2.COLOR_RGB2GRAY)
        bin_mask = (low_mask > 0) + 0

        images.append(low_im)
        masks.append(bin_mask)

    xtest = np.reshape(np.array(images[250:]), (-1, image_size*image_size*3))
    ytest = np.reshape(np.array(masks[250:]), (-1, image_size * image_size))
    xdata = np.reshape(np.array(images[:250]), (-1, image_size*image_size*3))
    ydata = np.reshape(np.array(masks[:250]), (-1, image_size * image_size))
    yval = np.reshape(np.array(masks[200:250]), (-1, image_size * image_size))
    xval = np.reshape(np.array(images[200:250]), (-1, image_size*image_size*3))
```

```
return xdata, xval, xtest, ydata, yval, ytest
```

```
In [ ]: #change the path address if put the data somewhere else
path = 'horses/'
image_size = 32;
xdata, xval, xtest, ydata, yval, ytest = load_horses_orig(path, image_size)
```

```
In [ ]: #helper function to drawing horse and its mask
def draw(image, mask):
    fig, (ax1,ax2) = plt.subplots(1,2)
    ax1.axis('off')
    ax2.axis('off')
    ax1.imshow(np.reshape(image, (image_size,image_size,3)))
    ax2.imshow(np.reshape(mask, (image_size,image_size)), cmap=plt.cm.gray)
    plt.show()
```

The task is to predict the mask for the horse given the image Mask is binary image shows the presence of the horse.

```
In [ ]: draw(xdata[0], ydata[0])
```



```
In [ ]: train_size = xdata.shape[0]
batch_size = 10
train_dataset = (tf.data.Dataset.from_tensor_slices(np.hstack((xdata, ydata))
    .shuffle(train_size).batch(batch_size))
```

The intersection over union (IOU) is a metric for measuring the performance of image segmentation. The perfect segmentation receives IOU of one.

```
In [ ]: # Do not change this cell
def iou(ytrue, yprediction):
    yp = yprediction
    yt = ytrue
    yp = yp > 0.5 + 0
    intersect = np.sum(np.minimum(yp, yt),1)
    union = np.sum(np.maximum(yp, yt),1)
    return np.average(intersect / (union+0.0))
```

```
In [ ]: assert iou(ydata, ydata) == 1.0
```

We can use feedforward MLP or CNN model for image segmentation. Here the input is the image and the output is the segmentation mask.

```
In [ ]: class NeuralNet(tf.keras.Model):

    def construct_CNN(self):
        # COMPLETE ME
        # The following code is a function to construct the CNN model.
        # This is accomplished by passing the data through convolution layer
        # Dropouts and BatchNormalization are also used to curb overfitting

        self.model = tf.keras.Sequential(
            [
                tf.keras.layers.Conv2D(image_size, (3, 3), activation='relu'),
                tf.keras.layers.BatchNormalization(),
                tf.keras.layers.MaxPooling2D((2, 2)),
                tf.keras.layers.Dropout(0.5),

                tf.keras.layers.Conv2D(128, (3, 3), activation='relu'),
                tf.keras.layers.BatchNormalization(),
                tf.keras.layers.MaxPooling2D((2, 2)),
                tf.keras.layers.Dropout(0.5),

                # tf.keras.layers.Conv2D(128, (3, 3), activation='relu'),
                # # tf.keras.layers.BatchNormalization(),
                # tf.keras.layers.MaxPooling2D((2, 2)),
                # tf.keras.layers.Dropout(0.4),

                # tf.keras.layers.Conv2D(256, (3, 3), activation='relu'),
                # tf.keras.layers.MaxPooling2D((2, 2)),
                # tf.keras.layers.Dropout(0.4),

                tf.keras.layers.Flatten(),
                tf.keras.layers.Dense(512, activation='relu'),
                tf.keras.layers.Dense(image_size*image_size)
            ]
        )
        pass

    def construct_MLP(self):
        self.model = tf.keras.Sequential(
            [
                tf.keras.layers.InputLayer(input_shape=(image_size, image_size)),
                tf.keras.layers.Flatten(),
                tf.keras.layers.Dense(500, activation='relu'),
                tf.keras.layers.Dropout(0.2, input_shape=(500,)),
                tf.keras.layers.Dense(20, activation='relu'),
                tf.keras.layers.Dense(image_size*image_size)
            ]
        )
```

```

def __init__(self, network_type = 'MLP'):
    super(NeuralNet, self).__init__()
    #DOCUMENT ME
    # SGD is the simplest optimizer that updates the weights in the direction
    # respect to the weights. It uses a constant learning rate.
    # self.optimizer = tf.keras.optimizers.SGD(0.1)
    # Adam (Adaptive Moment Estimation) combines ideas from RMSprop and
    # It adapts the learning rates of each parameter individually, allowing
    # handling of sparse gradients.
    # self.optimizer = tf.keras.optimizers.legacy.Adam(0.0001)
    #What are the other available optimizers
    #Test your code with different optimizers

    # RMSprop (Root Mean Squared Propagation) is an adaptive learning rate
    # moving average of the squared gradients. It helps in adapting to the
    # changing learning rates.

    self.optimizer = tf.keras.optimizers.legacy.RMSprop(0.0001)

    if network_type == 'MLP':
        self.construct_MLP();
    else:
        self.construct_CNN();

#DOCUMENT ME
# The following function is the forward step of the neural network.
# This step feeds the data from the neurons through the next layer.
# The weights and biases will be applied to the data and fed through the
# In our particular case if the predict flag is true then we apply the sigmoid
def forward(self, x, predict=True):
    if predict:
        return tf.nn.sigmoid(self.model(x))
    return self.model(x)

def get_loss(self, x, yt):
    x = tf.reshape(x, (-1, image_size, image_size, 3))
    yt = tf.reshape(yt, (-1, image_size * image_size))
    ylogits = self.forward(x, predict=False);

    #DOCUMENT ME
    # Here in the get_loss function we apply the sigmoid cross entropy loss
    # This is calculated in the function using the given logits and their
    # That cross entropy loss is then applied to the model using the reduce
    # across a tensor.
    cross_ent = tf.nn.sigmoid_cross_entropy_with_logits(logits=ylogits,
                                                         targets=yt)

    return tf.reduce_sum(cross_ent)

def train_step(self, xbatch,ybatch):

    #DOCUMENT ME
    # The gradient tape function computes the derivative of the loss with

```

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# We could also stack gradient tapes should we need to calculate high order gradients
# in our example.
with tf.GradientTape() as tape:
    loss = self.get_loss(xbatch, ybatch)

#DOCUMENT ME
# Here the gradient from the gradient tape is actually calculated with respect to
# from our model as the y values.
gradients = tape.gradient(loss, model.trainable_variables)

#DOCUMENT ME
# The gradients are then applied here which is essentially calculating the
# and the model is adjusted accordingly by adding those adjustments
self.optimizer.apply_gradients(zip(gradients, model.trainable_variables))
return tf.reduce_sum(loss)

def predict(self, x):
    y = self.forward(x, predict=True)
    return y.numpy() #tf.reshape(y, (-1, image_size, image_size)).numpy()

```

```

In [ ]: model = NeuralNet('CNN')
# model = NeuralNet('MLP')
train_iou = []
val_iou = []
test_iou = []
epoch = 1;
best_val_iou = -1;
best_test_iou = -1

```

```

In [ ]: #Adopt similar training loop for other problems

max_epoch = 5000

while epoch < max_epoch:
    loss = 0.0
    for batch in train_dataset:
        xbatch = batch[:, :, image_size*image_size*3]
        ybatch = batch[:, image_size*image_size*3:]
        xbatch = tf.cast(xbatch, tf.float32);
        ybatch = tf.cast(ybatch, tf.float32);
        loss += model.train_step(xbatch, ybatch);

    ydata_pred = model.predict(tf.reshape(xdata, (-1, image_size, image_size)))
    yval_pred = model.predict(tf.reshape(xval, (-1, image_size, image_size)))
    ytest_pred = model.predict(tf.reshape(xtest, (-1, image_size, image_size)))

    train_iou.append(iou(ydata, ydata_pred))
    val_iou.append(iou(yval, yval_pred))
    test_iou.append(iou(ytest, ytest_pred))

    if val_iou[-1] > best_val_iou:
        best_test_iou = test_iou[-1]
        best_val_iou = val_iou[-1]
        model.save_weights("best_model");

```

```
print("Epoch {}, Loss: {:.0.3}, IOU - Train: {:.0.3} Valid: {:.0.3} Test: {  
  
epoch += 1
```

Epoch 87, Loss: 9.2e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.603  
Epoch 88, Loss: 4.93e+02, IOU - Train: 0.998 Valid: 0.57 Test: 0.603  
Epoch 89, Loss: 7.83e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.603  
Epoch 90, Loss: 4.19e+02, IOU - Train: 0.998 Valid: 0.575 Test: 0.603  
Epoch 91, Loss: 8.03e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.603  
Epoch 92, Loss: 3.71e+02, IOU - Train: 0.999 Valid: 0.573 Test: 0.603  
Epoch 93, Loss: 5.39e+02, IOU - Train: 0.999 Valid: 0.579 Test: 0.603  
Epoch 94, Loss: 4.88e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.603  
Epoch 95, Loss: 3.67e+02, IOU - Train: 0.996 Valid: 0.567 Test: 0.603  
Epoch 96, Loss: 4.77e+02, IOU - Train: 0.997 Valid: 0.569 Test: 0.603  
Epoch 97, Loss: 4.94e+02, IOU - Train: 0.996 Valid: 0.585 Test: 0.604  
Epoch 98, Loss: 3.49e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.604  
Epoch 99, Loss: 3.29e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.604  
Epoch 100, Loss: 4.52e+02, IOU - Train: 0.999 Valid: 0.573 Test: 0.604  
Epoch 101, Loss: 3.57e+02, IOU - Train: 0.999 Valid: 0.577 Test: 0.604  
Epoch 102, Loss: 3.45e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.604  
Epoch 103, Loss: 2.81e+02, IOU - Train: 0.998 Valid: 0.576 Test: 0.604  
Epoch 104, Loss: 3.91e+02, IOU - Train: 0.999 Valid: 0.577 Test: 0.604  
Epoch 105, Loss: 3.04e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.604  
Epoch 106, Loss: 3.91e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.604  
Epoch 107, Loss: 3.79e+02, IOU - Train: 0.999 Valid: 0.579 Test: 0.604  
Epoch 108, Loss: 2.34e+02, IOU - Train: 0.998 Valid: 0.576 Test: 0.604  
Epoch 109, Loss: 3.37e+02, IOU - Train: 0.999 Valid: 0.58 Test: 0.604  
Epoch 110, Loss: 2.55e+02, IOU - Train: 0.999 Valid: 0.579 Test: 0.604  
Epoch 111, Loss: 3.04e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.604  
Epoch 112, Loss: 2.85e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.604  
Epoch 113, Loss: 2.44e+02, IOU - Train: 0.998 Valid: 0.583 Test: 0.604  
Epoch 114, Loss: 2.82e+02, IOU - Train: 0.999 Valid: 0.586 Test: 0.605  
Epoch 115, Loss: 2.51e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.605  
Epoch 116, Loss: 2.92e+02, IOU - Train: 0.999 Valid: 0.579 Test: 0.605  
Epoch 117, Loss: 2.31e+02, IOU - Train: 0.999 Valid: 0.579 Test: 0.605  
Epoch 118, Loss: 2.8e+02, IOU - Train: 0.999 Valid: 0.577 Test: 0.605  
Epoch 119, Loss: 3.27e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 120, Loss: 2.77e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 121, Loss: 2.1e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 122, Loss: 1.78e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 123, Loss: 3.05e+02, IOU - Train: 0.999 Valid: 0.573 Test: 0.605  
Epoch 124, Loss: 1.84e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 125, Loss: 2.1e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 126, Loss: 1.91e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 127, Loss: 1.91e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 128, Loss: 2.63e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.605  
Epoch 129, Loss: 2.27e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 130, Loss: 2.55e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 131, Loss: 1.99e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 132, Loss: 2.52e+02, IOU - Train: 0.999 Valid: 0.587 Test: 0.605  
Epoch 133, Loss: 1.83e+02, IOU - Train: 0.999 Valid: 0.58 Test: 0.605  
Epoch 134, Loss: 2.36e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 135, Loss: 2e+02, IOU - Train: 0.999 Valid: 0.577 Test: 0.605  
Epoch 136, Loss: 2e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 137, Loss: 1.95e+02, IOU - Train: 0.999 Valid: 0.578 Test: 0.605  
Epoch 138, Loss: 2.18e+02, IOU - Train: 0.999 Valid: 0.576 Test: 0.605  
Epoch 139, Loss: 2.01e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 140, Loss: 2.64e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 141, Loss: 2.01e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 142, Loss: 1.76e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605

Epoch 143, Loss: 2.32e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 144, Loss: 1.86e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 145, Loss: 1.6e+02, IOU - Train: 0.999 Valid: 0.58 Test: 0.605  
Epoch 146, Loss: 1.82e+02, IOU - Train: 0.999 Valid: 0.586 Test: 0.605  
Epoch 147, Loss: 1.82e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 148, Loss: 1.99e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 149, Loss: 99.0, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 150, Loss: 1.3e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 151, Loss: 1.99e+02, IOU - Train: 0.999 Valid: 0.587 Test: 0.605  
Epoch 152, Loss: 1.39e+02, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 153, Loss: 1.89e+02, IOU - Train: 0.999 Valid: 0.586 Test: 0.605  
Epoch 154, Loss: 1.63e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 155, Loss: 1.48e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 156, Loss: 1.39e+02, IOU - Train: 0.999 Valid: 0.581 Test: 0.605  
Epoch 157, Loss: 1.82e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 158, Loss: 1.6e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 159, Loss: 97.3, IOU - Train: 0.999 Valid: 0.586 Test: 0.605  
Epoch 160, Loss: 1.77e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 161, Loss: 1.37e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 162, Loss: 1.8e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 163, Loss: 1.02e+02, IOU - Train: 1.0 Valid: 0.585 Test: 0.605  
Epoch 164, Loss: 1.26e+02, IOU - Train: 1.0 Valid: 0.587 Test: 0.605  
Epoch 165, Loss: 1.46e+02, IOU - Train: 0.999 Valid: 0.585 Test: 0.605  
Epoch 166, Loss: 89.9, IOU - Train: 0.999 Valid: 0.587 Test: 0.605  
Epoch 167, Loss: 1.68e+02, IOU - Train: 1.0 Valid: 0.586 Test: 0.605  
Epoch 168, Loss: 1.02e+02, IOU - Train: 1.0 Valid: 0.586 Test: 0.605  
Epoch 169, Loss: 94.4, IOU - Train: 1.0 Valid: 0.584 Test: 0.605  
Epoch 170, Loss: 1.15e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 171, Loss: 1.54e+02, IOU - Train: 1.0 Valid: 0.585 Test: 0.605  
Epoch 172, Loss: 84.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.605  
Epoch 173, Loss: 87.2, IOU - Train: 0.999 Valid: 0.582 Test: 0.605  
Epoch 174, Loss: 1.07e+02, IOU - Train: 0.999 Valid: 0.583 Test: 0.605  
Epoch 175, Loss: 1.06e+02, IOU - Train: 1.0 Valid: 0.586 Test: 0.605  
Epoch 176, Loss: 1.15e+02, IOU - Train: 1.0 Valid: 0.587 Test: 0.605  
Epoch 177, Loss: 99.8, IOU - Train: 1.0 Valid: 0.588 Test: 0.605  
Epoch 178, Loss: 1.16e+02, IOU - Train: 0.999 Valid: 0.584 Test: 0.605  
Epoch 179, Loss: 1.01e+02, IOU - Train: 1.0 Valid: 0.588 Test: 0.605  
Epoch 180, Loss: 98.2, IOU - Train: 1.0 Valid: 0.583 Test: 0.605  
Epoch 181, Loss: 1.09e+02, IOU - Train: 1.0 Valid: 0.588 Test: 0.605  
Epoch 182, Loss: 53.4, IOU - Train: 1.0 Valid: 0.584 Test: 0.605  
Epoch 183, Loss: 81.5, IOU - Train: 1.0 Valid: 0.586 Test: 0.605  
Epoch 184, Loss: 66.5, IOU - Train: 1.0 Valid: 0.586 Test: 0.605  
Epoch 185, Loss: 1.19e+02, IOU - Train: 1.0 Valid: 0.59 Test: 0.608  
Epoch 186, Loss: 38.1, IOU - Train: 1.0 Valid: 0.591 Test: 0.608  
Epoch 187, Loss: 67.7, IOU - Train: 0.999 Valid: 0.586 Test: 0.608  
Epoch 188, Loss: 1.11e+02, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 189, Loss: 34.2, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 190, Loss: 83.4, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 191, Loss: 66.4, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 192, Loss: 74.9, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 193, Loss: 39.4, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 194, Loss: 85.1, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 195, Loss: 50.9, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 196, Loss: 74.4, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 197, Loss: 39.8, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 198, Loss: 48.4, IOU - Train: 1.0 Valid: 0.589 Test: 0.608



Epoch 199,	Loss: 52.0,	IOU -	Train: 1.0	Valid: 0.589	Test: 0.608
Epoch 200,	Loss: 68.1,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 201,	Loss: 50.0,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 202,	Loss: 66.9,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 203,	Loss: 49.0,	IOU -	Train: 1.0	Valid: 0.59	Test: 0.608
Epoch 204,	Loss: 52.7,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 205,	Loss: 53.7,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 206,	Loss: 35.8,	IOU -	Train: 1.0	Valid: 0.589	Test: 0.608
Epoch 207,	Loss: 65.3,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 208,	Loss: 30.6,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 209,	Loss: 51.4,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 210,	Loss: 61.1,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 211,	Loss: 28.0,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 212,	Loss: 34.3,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 213,	Loss: 31.1,	IOU -	Train: 1.0	Valid: 0.59	Test: 0.608
Epoch 214,	Loss: 66.8,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 215,	Loss: 22.9,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 216,	Loss: 30.2,	IOU -	Train: 1.0	Valid: 0.582	Test: 0.608
Epoch 217,	Loss: 36.6,	IOU -	Train: 1.0	Valid: 0.584	Test: 0.608
Epoch 218,	Loss: 45.3,	IOU -	Train: 1.0	Valid: 0.584	Test: 0.608
Epoch 219,	Loss: 41.0,	IOU -	Train: 1.0	Valid: 0.583	Test: 0.608
Epoch 220,	Loss: 18.5,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 221,	Loss: 56.1,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 222,	Loss: 43.3,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 223,	Loss: 40.2,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 224,	Loss: 33.1,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 225,	Loss: 17.9,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 226,	Loss: 38.8,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 227,	Loss: 26.2,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 228,	Loss: 29.4,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 229,	Loss: 17.7,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 230,	Loss: 13.7,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 231,	Loss: 49.7,	IOU -	Train: 1.0	Valid: 0.584	Test: 0.608
Epoch 232,	Loss: 11.3,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 233,	Loss: 33.3,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 234,	Loss: 30.9,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 235,	Loss: 8.99,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 236,	Loss: 19.1,	IOU -	Train: 1.0	Valid: 0.584	Test: 0.608
Epoch 237,	Loss: 30.3,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 238,	Loss: 20.2,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 239,	Loss: 11.4,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 240,	Loss: 19.3,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 241,	Loss: 8.21,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 242,	Loss: 25.4,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 243,	Loss: 32.7,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 244,	Loss: 3.0,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 245,	Loss: 21.8,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 246,	Loss: 10.7,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 247,	Loss: 27.1,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 248,	Loss: 11.9,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 249,	Loss: 26.2,	IOU -	Train: 1.0	Valid: 0.586	Test: 0.608
Epoch 250,	Loss: 12.8,	IOU -	Train: 1.0	Valid: 0.587	Test: 0.608
Epoch 251,	Loss: 20.7,	IOU -	Train: 1.0	Valid: 0.585	Test: 0.608
Epoch 252,	Loss: 5.04,	IOU -	Train: 1.0	Valid: 0.589	Test: 0.608
Epoch 253,	Loss: 15.3,	IOU -	Train: 1.0	Valid: 0.588	Test: 0.608
Epoch 254,	Loss: 12.1,	IOU -	Train: 1.0	Valid: 0.584	Test: 0.608

Epoch 255, Loss: 11.3, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 256, Loss: 11.3, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 257, Loss: 23.7, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 258, Loss: 13.4, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 259, Loss: 5.48, IOU - Train: 1.0 Valid: 0.59 Test: 0.608  
Epoch 260, Loss: 8.11, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 261, Loss: 18.5, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 262, Loss: 11.6, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 263, Loss: 5.11, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 264, Loss: 3.25, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 265, Loss: 8.36, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 266, Loss: 9.06, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 267, Loss: 6.25, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 268, Loss: 12.8, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 269, Loss: 0.472, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 270, Loss: 3.61, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 271, Loss: 13.4, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 272, Loss: 14.9, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 273, Loss: 0.6, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 274, Loss: 4.58, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 275, Loss: 3.5, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 276, Loss: 9.55, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 277, Loss: 0.96, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 278, Loss: 11.6, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 279, Loss: 14.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 280, Loss: 0.285, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 281, Loss: 0.0906, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 282, Loss: 0.159, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 283, Loss: 9.08, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 284, Loss: 0.426, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 285, Loss: 4.06, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 286, Loss: 8.58, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 287, Loss: 0.528, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 288, Loss: 3.39, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 289, Loss: 3.23, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 290, Loss: 2.58, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 291, Loss: 0.0661, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 292, Loss: 2.91, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 293, Loss: 7.67, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 294, Loss: 1.54, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 295, Loss: 6.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 296, Loss: 0.197, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 297, Loss: 0.0228, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 298, Loss: 0.0171, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 299, Loss: 0.0213, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 300, Loss: 12.7, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 301, Loss: 7.75, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 302, Loss: 6.47, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 303, Loss: 0.221, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 304, Loss: 0.0161, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 305, Loss: 0.0127, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 306, Loss: 0.0556, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 307, Loss: 4.33, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 308, Loss: 0.0832, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 309, Loss: 0.0116, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 310, Loss: 0.00724, IOU - Train: 1.0 Valid: 0.587 Test: 0.608

Epoch 311, Loss: 0.0142, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 312, Loss: 10.7, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 313, Loss: 1.79, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 314, Loss: 4.25, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 315, Loss: 0.314, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 316, Loss: 0.0092, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 317, Loss: 0.00575, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 318, Loss: 0.00471, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 319, Loss: 0.0255, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 320, Loss: 6.21, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 321, Loss: 1.1, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 322, Loss: 5.14, IOU - Train: 1.0 Valid: 0.591 Test: 0.608  
Epoch 323, Loss: 2.16, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 324, Loss: 0.258, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 325, Loss: 0.00705, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 326, Loss: 3.11, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 327, Loss: 1.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 328, Loss: 0.0062, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 329, Loss: 0.00422, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 330, Loss: 0.00292, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 331, Loss: 0.00224, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 332, Loss: 0.00143, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 333, Loss: 17.6, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 334, Loss: 0.21, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 335, Loss: 0.0051, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 336, Loss: 0.00242, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 337, Loss: 0.00122, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 338, Loss: 0.000947, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 339, Loss: 0.000603, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 340, Loss: 0.000982, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 341, Loss: 0.00933, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 342, Loss: 5.38, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 343, Loss: 0.0108, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 344, Loss: 0.0663, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 345, Loss: 5.22, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 346, Loss: 0.00387, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 347, Loss: 0.00254, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 348, Loss: 0.000875, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 349, Loss: 0.000437, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 350, Loss: 0.000334, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 351, Loss: 0.000515, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 352, Loss: 5.24, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 353, Loss: 0.00645, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 354, Loss: 0.00232, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 355, Loss: 0.00075, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 356, Loss: 0.000479, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 357, Loss: 0.000168, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 358, Loss: 0.156, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 359, Loss: 5.96, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 360, Loss: 0.281, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 361, Loss: 5.83e-05, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 362, Loss: 0.000111, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 363, Loss: 0.000192, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 364, Loss: 0.000798, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 365, Loss: 2.72, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 366, Loss: 0.0125, IOU - Train: 1.0 Valid: 0.586 Test: 0.608

Epoch 367, Loss: 0.00199, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 368, Loss: 0.000547, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 369, Loss: 0.000239, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 370, Loss: 0.000107, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 371, Loss: 7.37e-05, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 372, Loss: 3.36e-05, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 373, Loss: 1.94e-05, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 374, Loss: 1.84e-05, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 375, Loss: 4.8e-05, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 376, Loss: 0.616, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 377, Loss: 0.1, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 378, Loss: 1.7, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 379, Loss: 16.5, IOU - Train: 1.0 Valid: 0.589 Test: 0.608  
Epoch 380, Loss: 0.0138, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 381, Loss: 0.000379, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 382, Loss: 0.00018, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 383, Loss: 9.78e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 384, Loss: 3.43e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 385, Loss: 2.41e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 386, Loss: 2.87e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 387, Loss: 1.37e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 388, Loss: 7.58e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 389, Loss: 0.266, IOU - Train: 1.0 Valid: 0.582 Test: 0.608  
Epoch 390, Loss: 0.0286, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 391, Loss: 4.9e-05, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 392, Loss: 3.73e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 393, Loss: 2.81e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 394, Loss: 2.16e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 395, Loss: 1.32e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 396, Loss: 8.94e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 397, Loss: 5.84e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 398, Loss: 2.38e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 399, Loss: 4.05e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 400, Loss: 5.01e-06, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 401, Loss: 0.058, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 402, Loss: 0.0607, IOU - Train: 1.0 Valid: 0.582 Test: 0.608  
Epoch 403, Loss: 0.00232, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 404, Loss: 3.11e-05, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 405, Loss: 2.55e-05, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 406, Loss: 1.91e-05, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 407, Loss: 7.39e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 408, Loss: 3.81e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 409, Loss: 1.07e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 410, Loss: 5.96e-07, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 411, Loss: 2.38e-07, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 412, Loss: 1.19e-07, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 413, Loss: 1.19e-07, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 414, Loss: 9.78e-06, IOU - Train: 1.0 Valid: 0.588 Test: 0.608  
Epoch 415, Loss: 0.0839, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 416, Loss: 6.56e-06, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 417, Loss: 4.17e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 418, Loss: 3.1e-06, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 419, Loss: 2.03e-06, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 420, Loss: 1.67e-06, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 421, Loss: 1.07e-06, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 422, Loss: 4.77e-07, IOU - Train: 1.0 Valid: 0.585 Test: 0.608

Epoch 423, Loss: 2.38e-07, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 424, Loss: 2.38e-07, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 425, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 426, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 427, Loss: 0.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 428, Loss: 2.01e-05, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 429, Loss: 4.88, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 430, Loss: 0.0138, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 431, Loss: 0.000297, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 432, Loss: 0.000253, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 433, Loss: 0.000191, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 434, Loss: 7.39e-05, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 435, Loss: 3.79e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 436, Loss: 1.56e-05, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 437, Loss: 5.6e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 438, Loss: 2.03e-06, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 439, Loss: 1.19e-06, IOU - Train: 1.0 Valid: 0.583 Test: 0.608  
Epoch 440, Loss: 3.58e-07, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 441, Loss: 1.19e-07, IOU - Train: 1.0 Valid: 0.584 Test: 0.608  
Epoch 442, Loss: 0.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
Epoch 443, Loss: 0.0, IOU - Train: 1.0 Valid: 0.585 Test: 0.608  
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Epoch 447, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 448, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 449, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 450, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 451, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 452, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 453, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 454, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 455, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 456, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 457, Loss: 0.0, IOU - Train: 1.0 Valid: 0.586 Test: 0.608  
Epoch 458, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 459, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 460, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
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Epoch 474, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 475, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 476, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 477, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608  
Epoch 478, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608

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Epoch 479, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 480, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 481, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 482, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 483, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 484, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 485, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 486, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 487, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 488, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 489, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 490, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 491, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 492, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 493, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 494, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 495, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 496, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 497, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 498, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608
Epoch 499, Loss: 0.0, IOU - Train: 1.0 Valid: 0.587 Test: 0.608

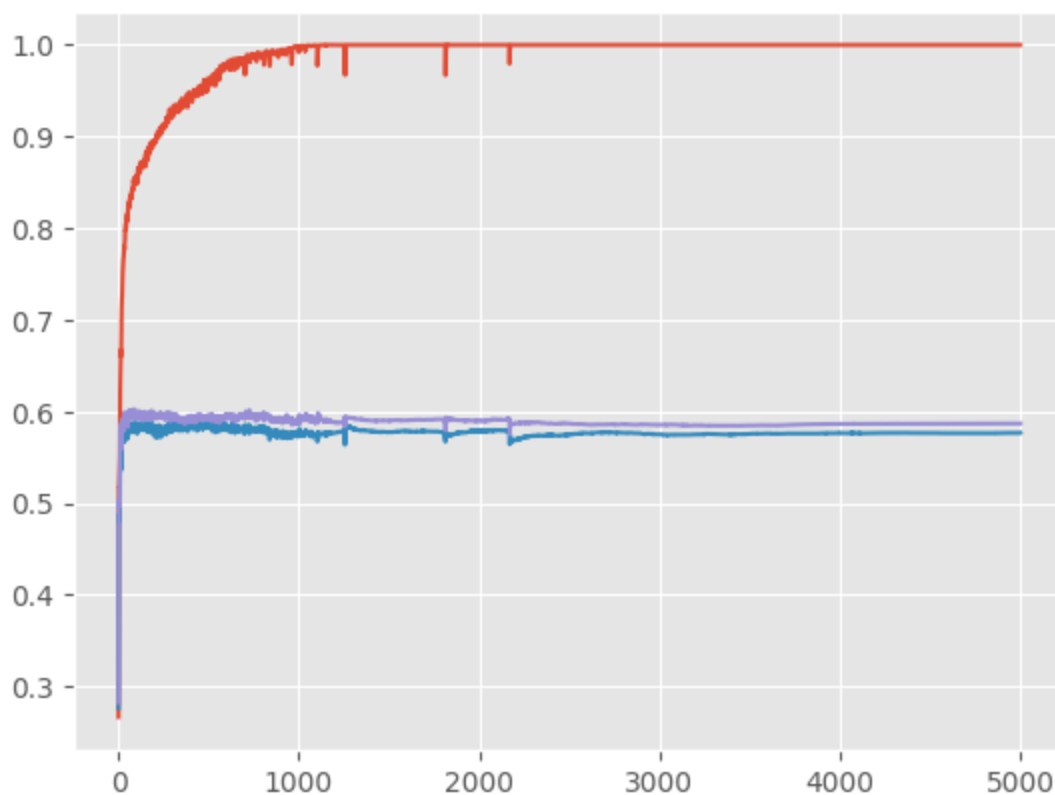
```

```

In [ ]: fig, ax = plt.subplots(1,1)
        pd.Series(train_iou).plot(ax=ax)
        pd.Series(val_iou).plot(ax=ax)
        pd.Series(test_iou).plot(ax=ax)
        fig.canvas.draw()

        draw(xdata[0], ydata_pred[0])

```

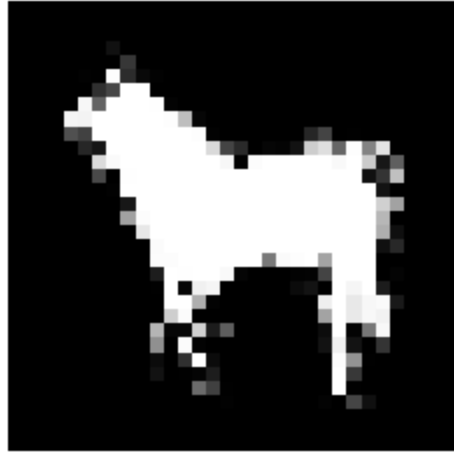




```
In [ ]: model.load_weights("best_model")  
ypred = model.predict(tf.reshape(xtest, (-1, image_size, image_size, 3)));
```

```
In [ ]: draw(xtest[10], ypred[10])  
draw(xtest[25], ypred[25])  
draw(xtest[20], ypred[20])
```





```
In [ ]: iou(ytest, ypred)
```

```
Out[ ]: 0.6084324036689871
```

```
In [ ]: tf.config.list_physical_devices('GPU')
```

```
Out[ ]: [PhysicalDevice(name='/physical_device:GPU:0', device_type='GPU')]
```