ESE 546, FALL 2020

HOMEWORK 5

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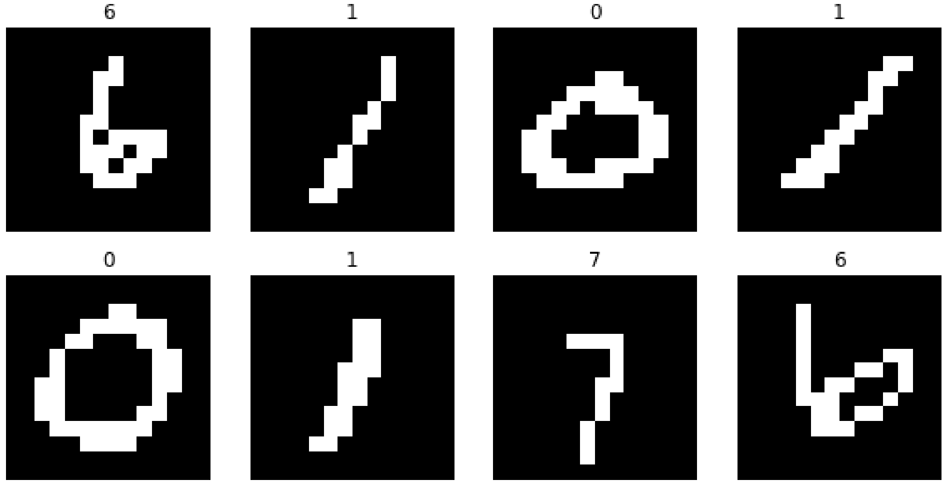
Solution 1 (Time spent: 10 hours)**.** Plots from the Jupyter notebook attached here for reference.

(1) Plot of Binarized and 14*14 subsampled images of MNIST



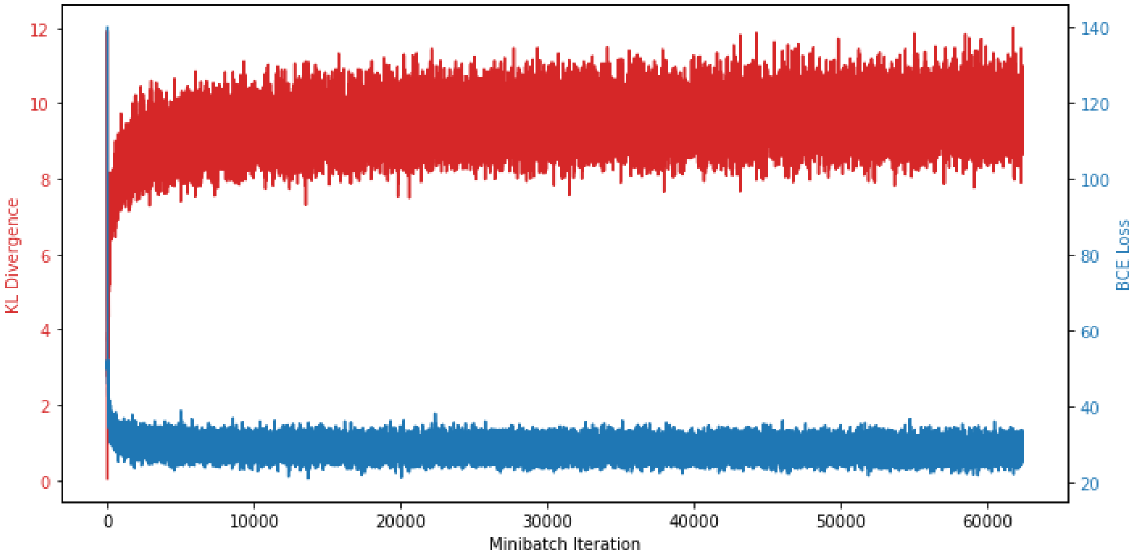
(2) Encoder and Decoder classes.

```
class Encoder(nn.Module):
    def __init__(self):
        super(Encoder, self).__init__()
        self.fc1 = nn.Linear(196, 128)
        self.fc2 = nn.Linear(128, 16)
        self.fc3 = nn.Linear(128, 16)

    def forward(self, x):
        reshaped = x.reshape(x.shape[0], -1)
        out = torch.tanh(self.fc1(reshaped))
        fc2_out = self.fc2(out)
        fc3_out = self.fc3(out)

        mu = (fc2_out[:, :8] + fc3_out[:, :8])/2
        logvar = (fc2_out[:, 8:] + fc3_out[:, 8:])/2

        std = logvar.mul(0.5).exp_()
        eps = torch.randn_like(std)
        z = eps.mul(std).add_(mu)
        return z, mu, logvar

class Decoder(nn.Module):
    def __init__(self):
        super(Decoder, self).__init__()
        self.fc1 = nn.Linear(8, 128)
        self.fc2 = nn.Linear(128, 196)

    def forward(self, x):
        out = torch.tanh(self.fc1(x))
        out = torch.sigmoid(self.fc2(out))
        return out
```

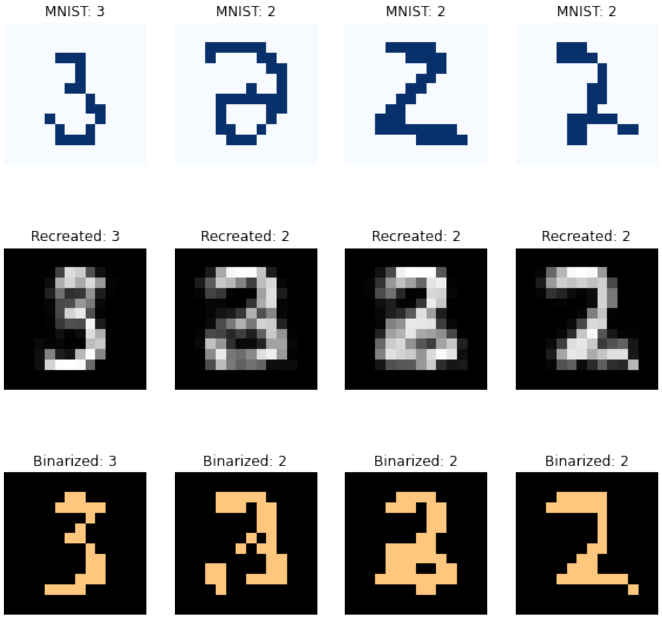
Loss functions.

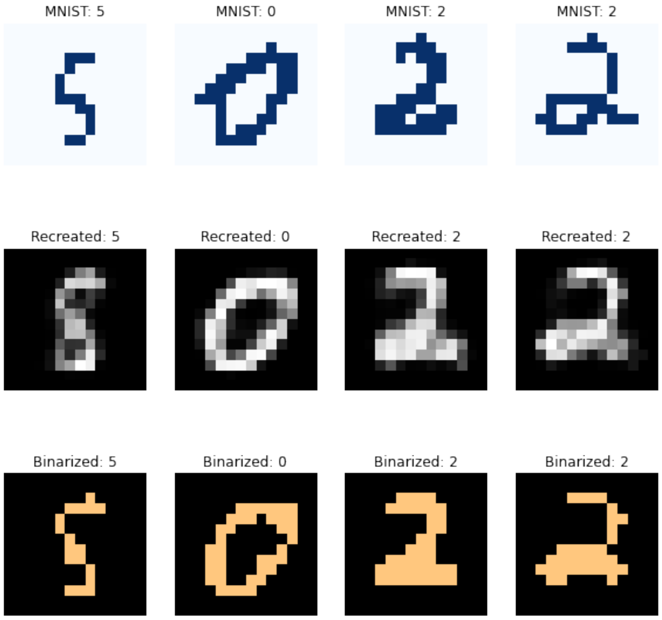
```
def KL(mu, sigma):
    contribution = 1 + sigma - mu**2 - torch.exp(sigma)
    return (torch.sum(-contribution/2))

def TotalLoss(x, mu, sigma, decoding):
    kl_loss = KL(mu, sigma)

    bce =  F.binary_cross_entropy(decoding,
                                  x.view(-1, 196),
                                  reduction=’sum’)
    return (kl_loss + bce, kl_loss, bce)
```

(3) Plot of first and second term of ELBO as a function of the number of weight updates.

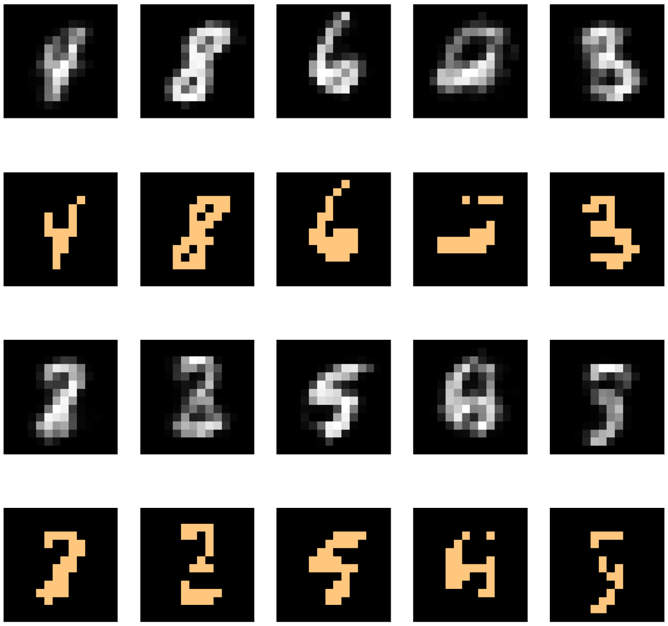


(4) Reconstruction of MNIST images using the Autoencoder.





(5) Images created by sampling from the generative model and running the decoder.



Solution 2 (Time spent: 1 hour)**.** Your solution goes here.