Homework 3: Latent Variable Models

Deliverable: This PDF write-up by **Tuesday March 10th, 23:59pm**. Your PDF should be generated by simply replacing the placeholder images of this LaTeX document with the appropriate solution images that will be generated automatically when solving each question. The solution images are automatically generated and saved using the accompanying IPython notebook. Your PDF is to be submitted into Gradescope. This PDF already contains a few solution images. These images will allow you to check your own solution to ensure correctness.

Question 1: VAEs on 2D Data [20pt]

(a) **[10pt] Data from a Full Covariance Gaussian**

Final Full -ELBO: 4.4388, Reconstruction Loss: 2.7630, KL Loss: 1.6758 (Dataset 1)

(a) Training curve   (b) Samples with Noise   (c) Samples without Noise

Figure 1: Results for Dataset 1

Final Full -ELBO: 0.0000, Reconstruction Loss: 0.0000, KL Loss: 0.0000 (Dataset 2)

(a) Training curve   (b) Samples with Noise   (c) Samples without Noise

Figure 2: Results for Dataset 2

(b) [**10pt**] **Data from a Diagonal Gaussian**

Final Full -ELBO: 4.4213, Reconstruction Loss: 4.4094, KL Loss: 0.0119 (Dataset 1)

(a) Training curve   (b) Samples with Noise   (c) Samples without Noise
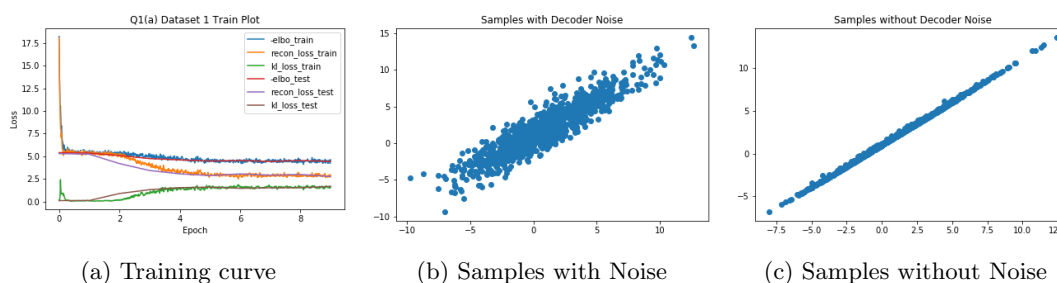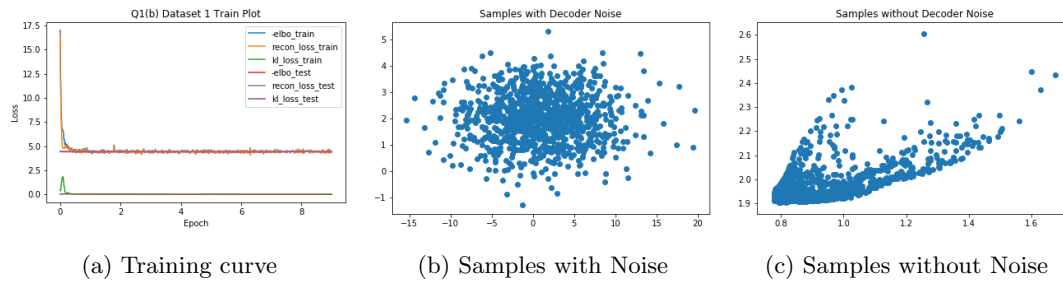
Figure 3: Results for Dataset 1

Final Full -ELBO: 0.0000, Reconstruction Loss: 0.0000, KL Loss: 0.0000 (Dataset 2)

Placeholder   Placeholder   Placeholder

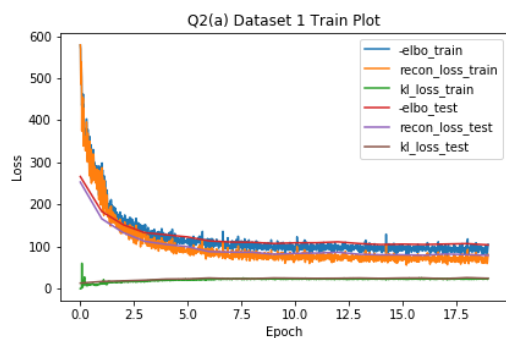(a) Training curve   (b) Samples with Noise   (c) Samples without Noise
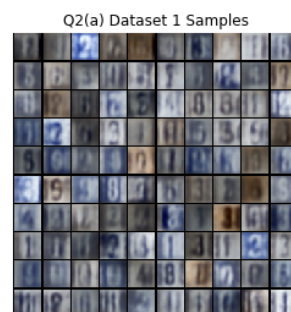
Figure 4: Results for Dataset 2

Answer: Your answer to the relfection portion of part (b) reflection here (replace this text)

Question 2: VAEs on Images [40pt]

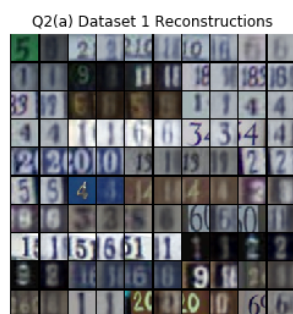(a) **[20pt] VAE**

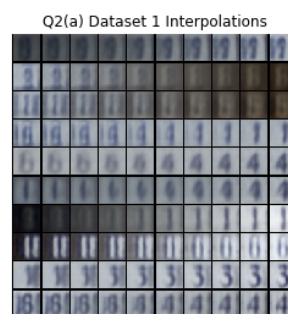Final Full -ELBO: 104.0417, Reconstruction Loss: 79.3798, KL Loss: 24.6620 (Dataset 1)

(a) Training Curve

(b) Samples

(c) Reconstructions

(d) Interpolations

Figure 5: Results for Dataset 1

Final Full -ELBO: 0.0000, Reconstruction Loss: 0.0000, KL Loss: 0.0000 (Dataset 2)

Placeholder

Placeholder

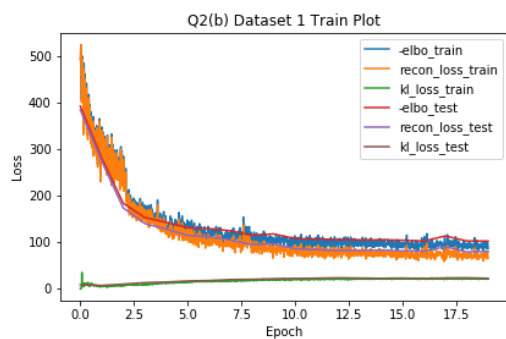(a) Training Curve

(b) Samples

Placeholder

Placeholder

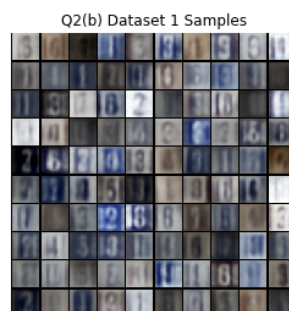(c) Reconstructions

(d) Interpolations

Figure 6: Results for Dataset 2
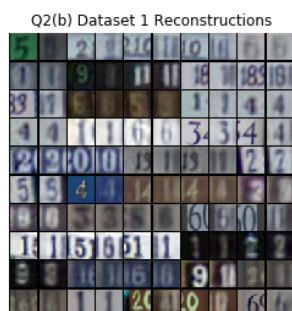
(b) **[20pt] VAE with AF Prior**

Final Full -ELBO: 102.5659, Reconstruction Loss: 80.2548, KL Loss: 22.3111 (Dataset 1)
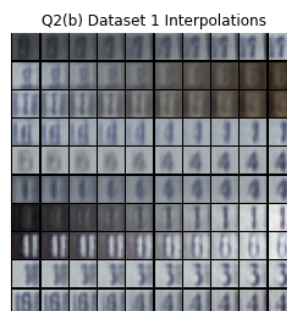

(a) Training Curve

(b) Samples

(c) Reconstructions

(d) Interpolations

Figure 7: Results for Dataset 1

Final Full -ELBO: 0.0000, Reconstruction Loss: 0.0000, KL Loss: 0.0000 (Dataset 2)

Placeholder

Placeholder

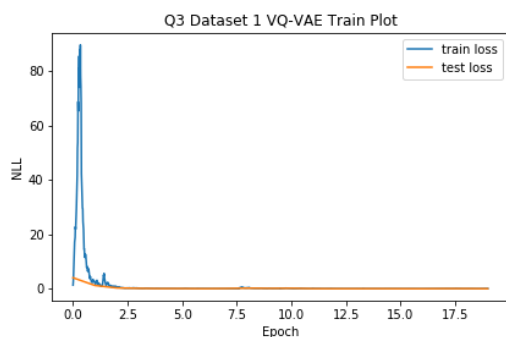(a) Training Curve

(b) Samples

Placeholder

Placeholder

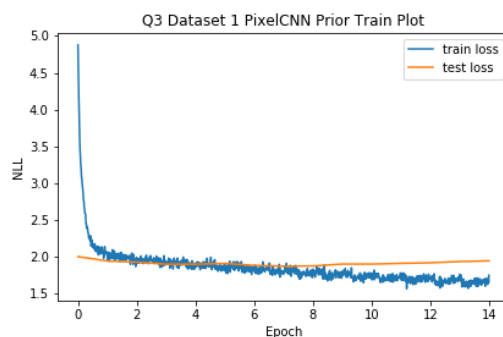(c) Reconstructions

(d) Interpolations

Figure 8: Results for Dataset 2
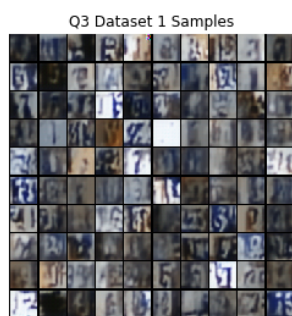
Question 3: VQ-VAE [40pt]

Final VQ-VAE Test Loss: 0.0286, PixelCNN Prior Test Los: 1.9440 (Dataset 1)
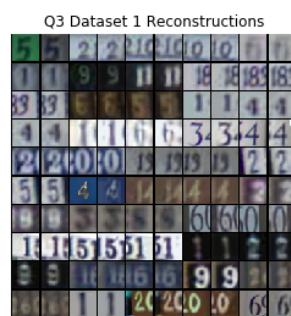

(a) VQ-VAE Training Curve

(b) PixelCNN Prior Training Curve

(c) Samples

(d) Reconstructions

Figure 9: Results for Dataset 1

Final VQ-VAE Test Loss: 0.0000, PixelCNN Prior Test Los: 0.0000 (Dataset 2)

Placeholder

Placeholder

(a) VQ-VAE Training Curve

(b) PixelCNN Prior Training Curve

Placeholder

Placeholder

(c) Samples

(d) Reconstructions

Figure 10: Results for Dataset 1

Question 4: Bonus [10pt]

1. **[5pt] Improving VQ-VAE Results**

   Final VQ-VAE Test Loss: 0.0000, PixelCNN Prior Test Los: 0.0000

   Placeholder

   Placeholder

   (a) VQ-VAE Training Curve

   (b) PixelCNN Prior Training Curve

   Placeholder

   Placeholder

   (c) Samples

   (d) Reconstructions

   Figure 11: Results for CIFAR10

2. bf [5pt] PixelVAE

Final Full -ELBO: 0.0000, Reconstruction Loss: 0.0000, KL Loss: 0.0000

Placeholder   Placeholder   Placeholder

(a) Training curve   (b) Samples   (c) Reconstructions

Figure 12: Results for MNIST