

## Homework 2: Latent Variable Models

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**Deliverable:** This PDF write-up by **Wed February 21st, 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, Recon Loss: 2.7630, KL Loss: 1.6758 (Dataset 1)

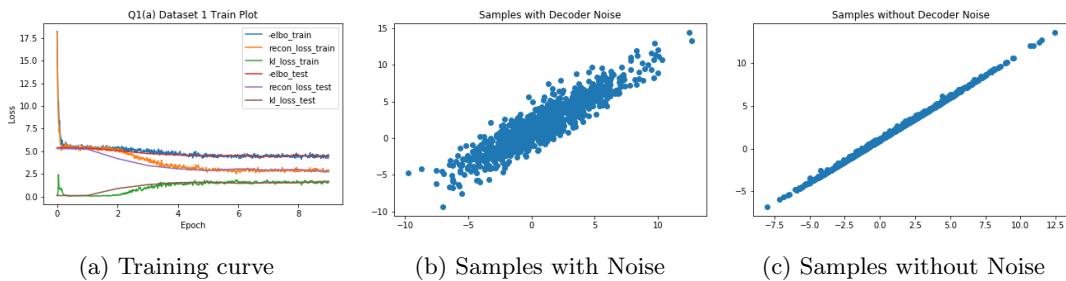


Figure 1: Results for Dataset 1

Final Full -ELBO: **FILL**, Recon Loss: **FILL**, KL Loss: **FILL** (Dataset 2)

Placeholder

Placeholder

Placeholder

(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, Recon Loss: 4.4094, KL Loss: 0.0119 (Dataset 1)

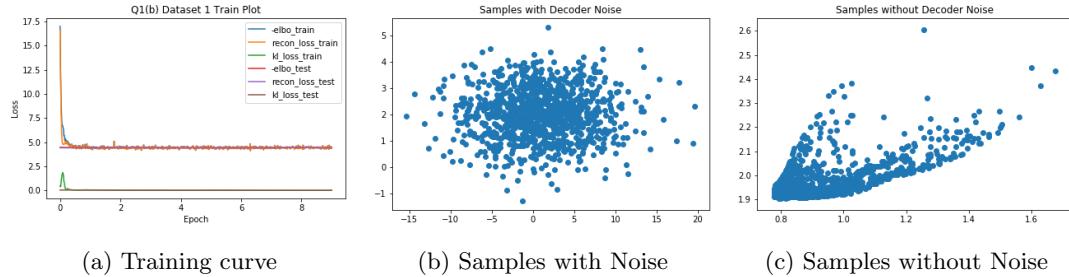


Figure 3: Results for Dataset 1

Final Full -ELBO: **FILL**, Recon Loss: **FILL**, KL Loss: **FILL** (Dataset 2)

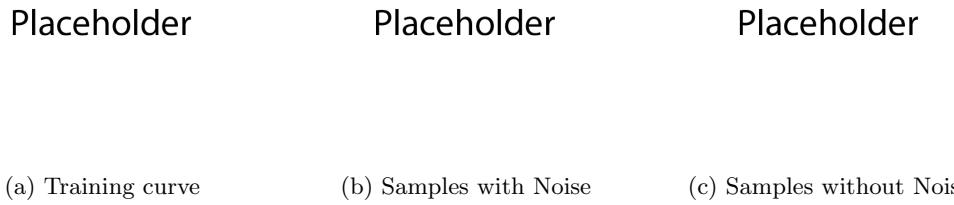


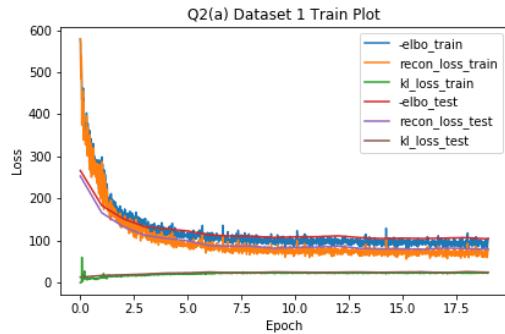
Figure 4: Results for Dataset 2

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

**Question 2: VAEs on Images [40pt]**

## (a) [20pt] VAE

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



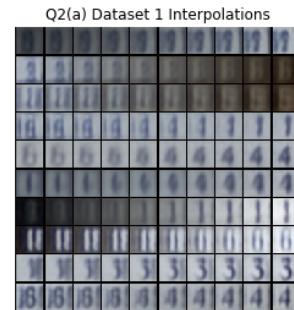
(a) Training Curve



(b) Samples



(c) Reconstructions



(d) Interpolations

Figure 5: Results for Dataset 1

Final Full -ELBO: **FILL**, Recon Loss: **FILL**, KL Loss: **FILL** (Dataset 2)

Placeholder

Placeholder

(a) Training Curve

(b) Samples

Placeholder

Placeholder

(c) Reconstructions

(d) Interpolations

Figure 6: Results for Dataset 2

## (b) [20pt] Hierarchical VAE with Learned Prior

Final Full -ELBO: 107.9378, Recon Loss 90.8240, KL Loss 17.1138 (Dataset 1)

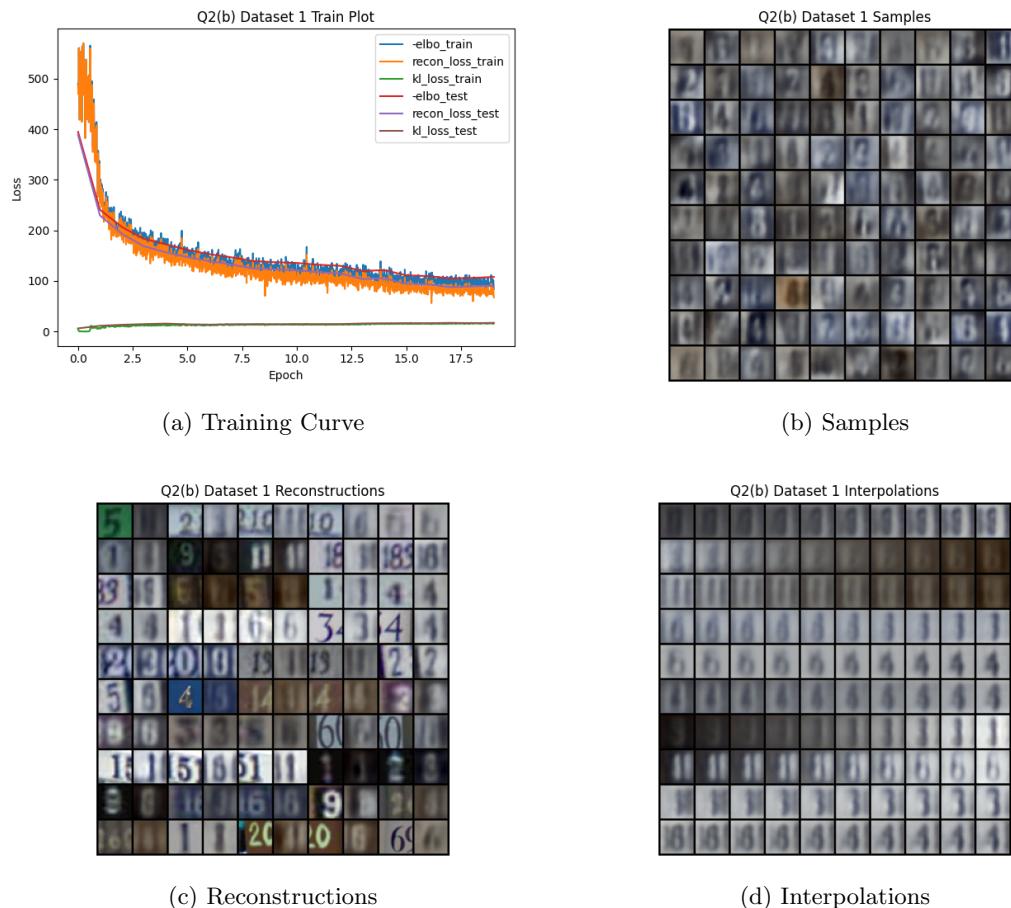


Figure 7: Results for Dataset 1

Final Full -ELBO: **FILL**, Recon Loss: **FILL**, KL Loss: **FILL** (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: 0.2525, Transformer Prior Test Loss: 1.9678 (Dataset 1)

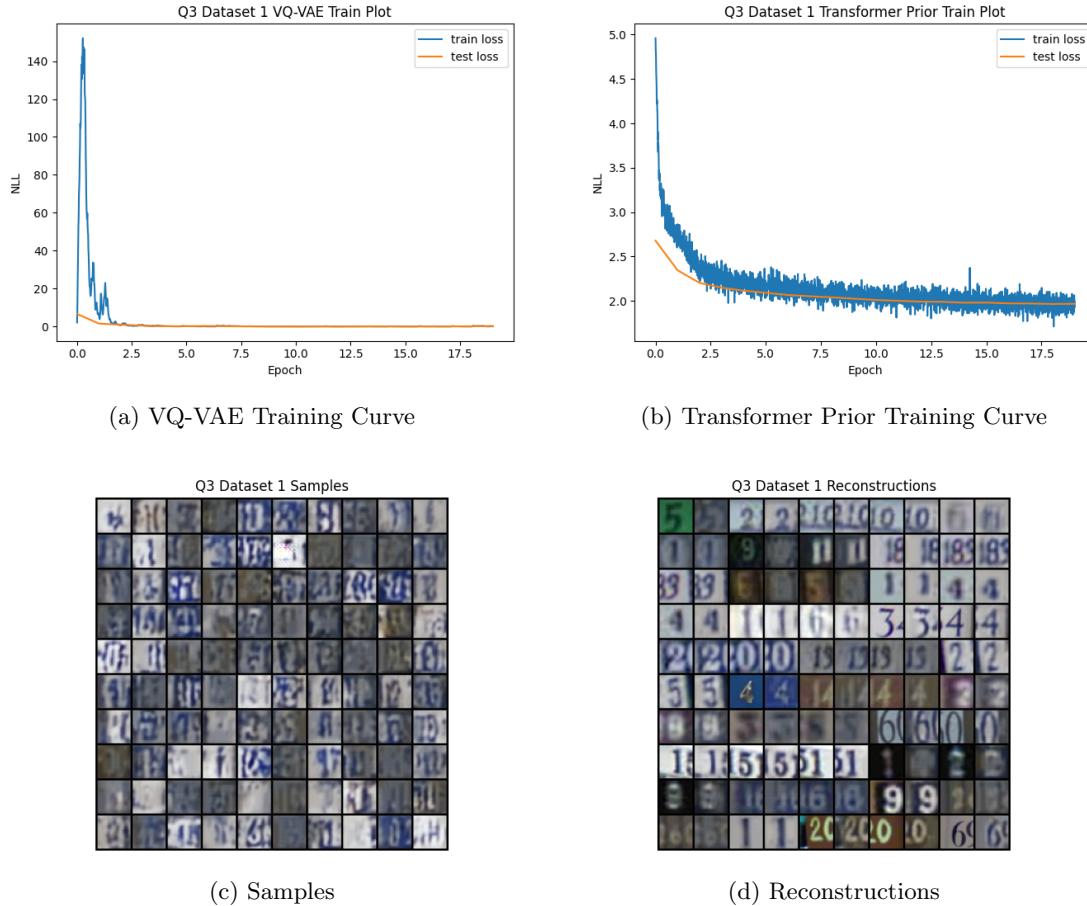


Figure 9: Results for Dataset 1

Final VQ-VAE Test Loss: **FILL**, PixelCNN Prior Test Los: **FILL** (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