Homework 1: Autoregressive Models

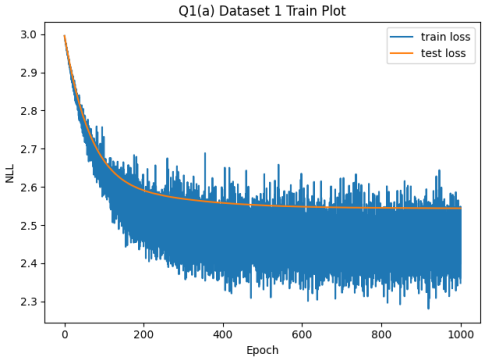
Name: YOUR NAME
Student ID: YOUR STUDENT ID

Deliverable: This PDF write-up by **Tuesday February 7th, 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. Submit this PDF, your iPython notebook, and any other code you wrote to Gradescope!

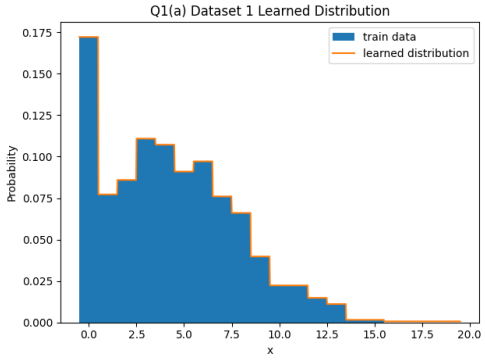
Question 1: 1D Data

(a) [10pt] Fitting a Histogram

Final test loss for dataset 1: 2.562 nats / dim

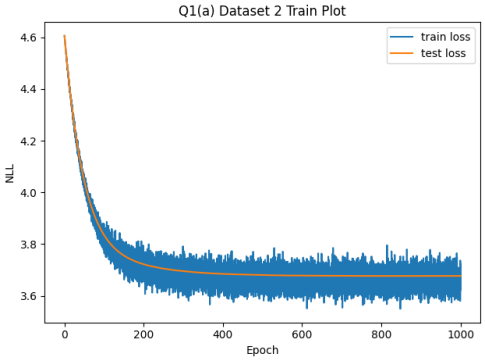


(a) Dataset 1: Training curve

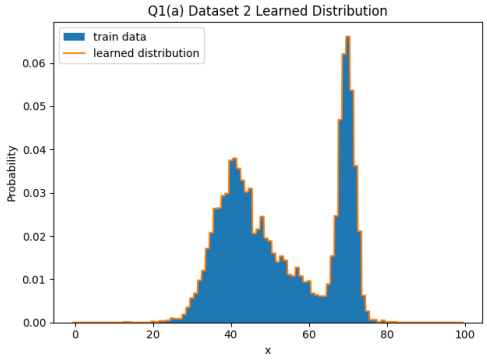


(b) Dataset 1: Learned distribution

Final test loss for dataset 2: FILL IN HERE nats / dim



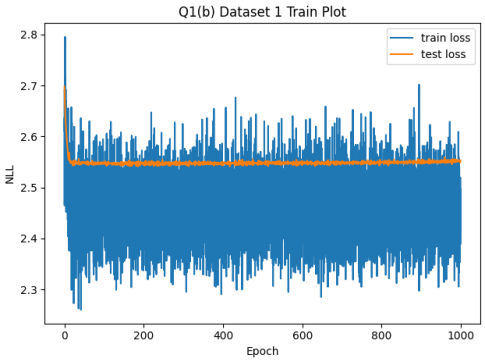
(a) Dataset 2: Training curve



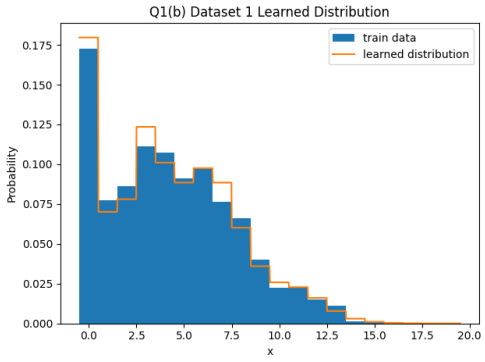
(b) Dataset 2: Learned distribution

(b) **[10pt] Fitting Discretized Mixture of Logistics**

Final test loss for dataset 1: 2.555 nats / dim

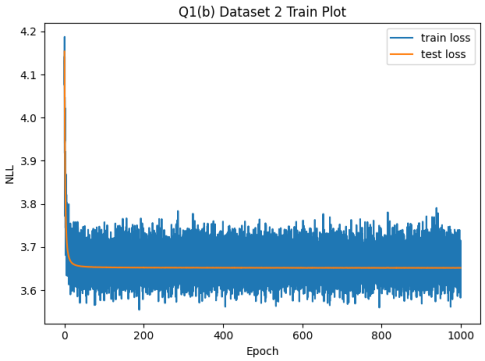


(a) Dataset 1: Training curve

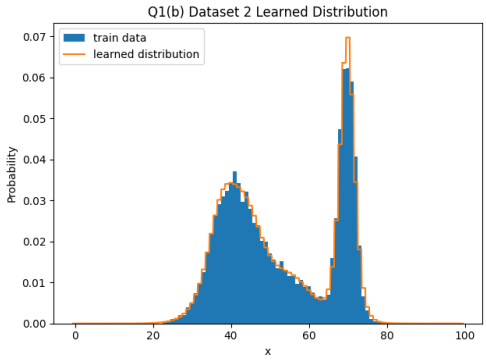


(b) Dataset 1: Learned distribution

Final test loss for dataset 2: FILL IN HERE nats / dim



(a) Dataset 2: Training curve

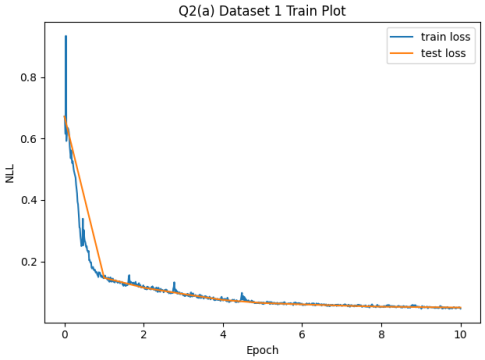


(b) Dataset 2: Learned distribution

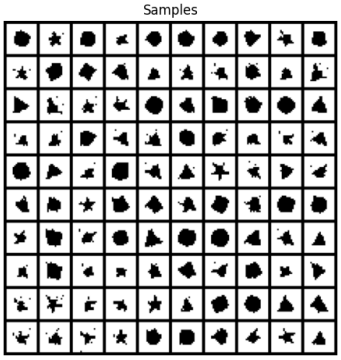
Question 2: PixelCNNs

(a) [15pt] PixelCNNs on Shapes and MNIST

Final test loss for dataset 1: 0.0420 nats / dim

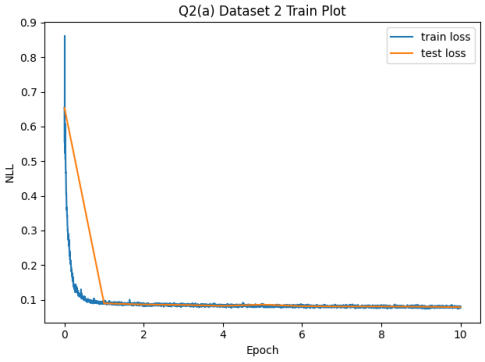


(a) Dataset 1: Training curve

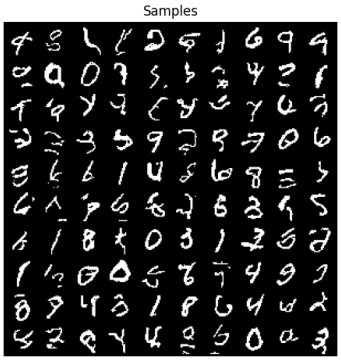


(b) Dataset 1: Samples

Final test loss for dataset 2: FILL IN HERE nats / dim



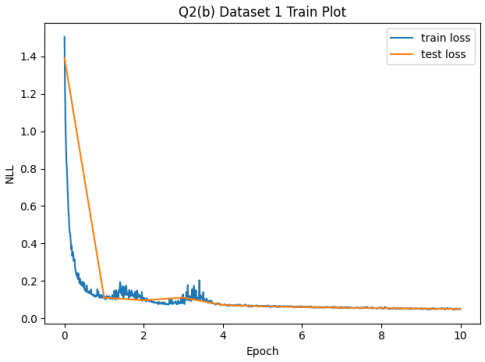
(a) Dataset 2: Training curve



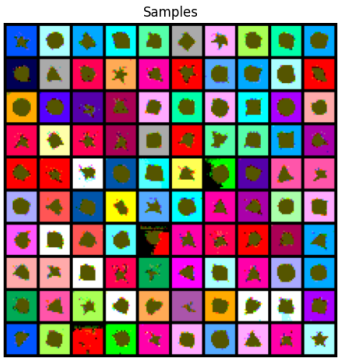
(b) Dataset 2: Samples

(b) **[15pt] PixelCNN on Colored Shapes and MNIST: Independent Color Channels**

Final test loss for dataset 1: 0.0444 nats / dim

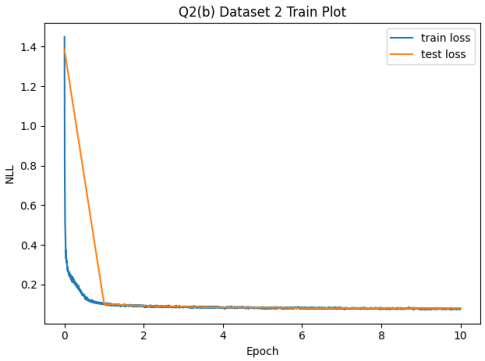


(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: FILL IN HERE nats / dim



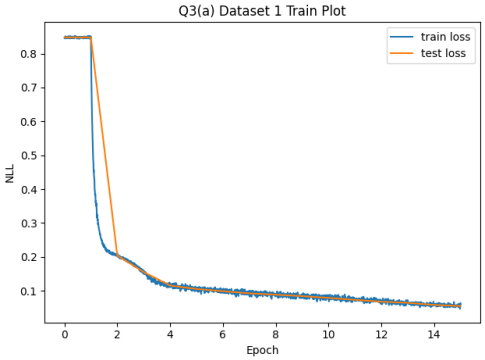
(a) Dataset 2: Training curve

(b) Dataset 2: Samples

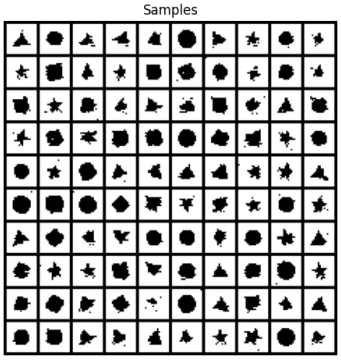
Question 3: Causal Transformer - iGPT

(a) [15pt] Autoregressive Transformer on Shapes and MNIST

Final test loss for dataset 1: 0.0397 nats / dim

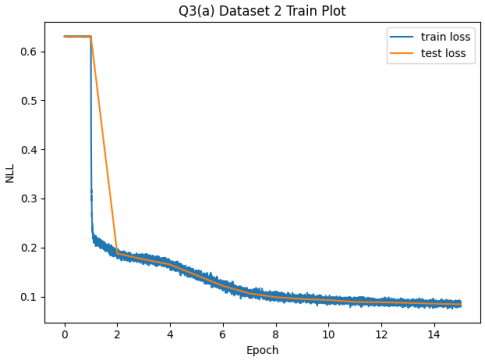


(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: FILL IN HERE nats / dim

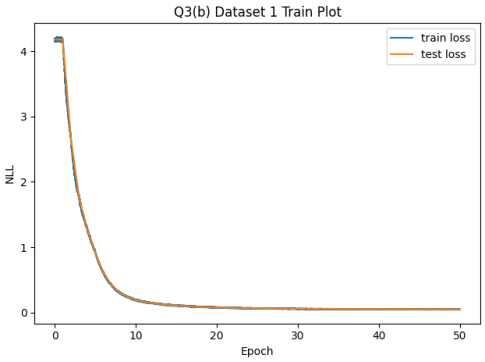


(a) Dataset 2: Training curve

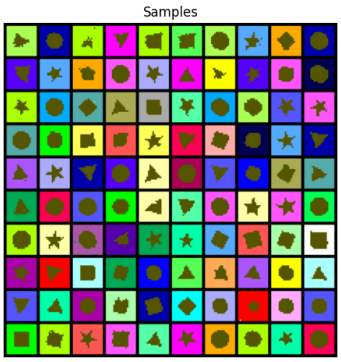
(b) Dataset 2: Samples

(b) **[15pt] Autoregressive Transformer on Colored Shapes and MNIST**

Final test loss for dataset 1: 0.0541 nats / dim

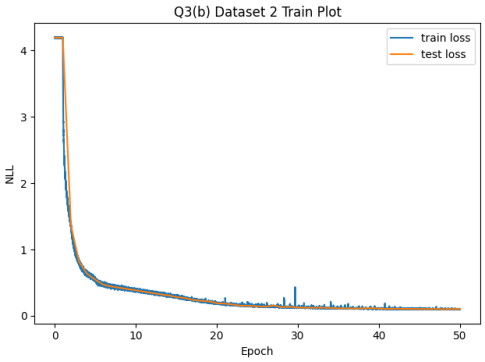


(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: FILL IN HERE nats / dim



(a) Dataset 2: Training curve

(b) Dataset 2: Samples

(c) **[15pt] K,V Caching for Improved Inference**

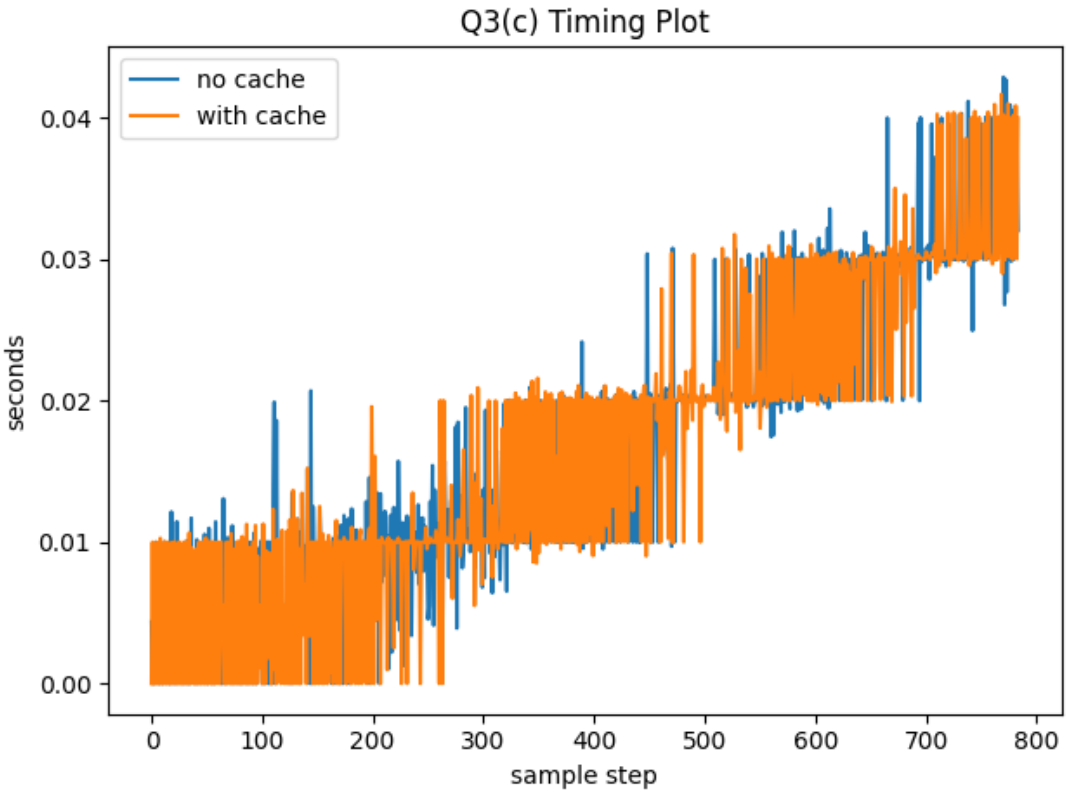


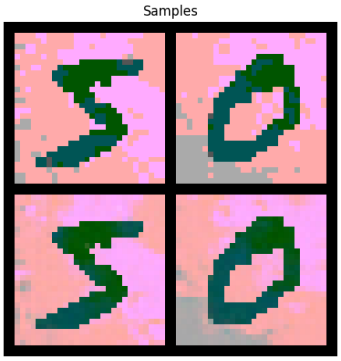
Figure 13: Dataset 2: Inference Speed

(a) Dataset 2: Samples (no caching)

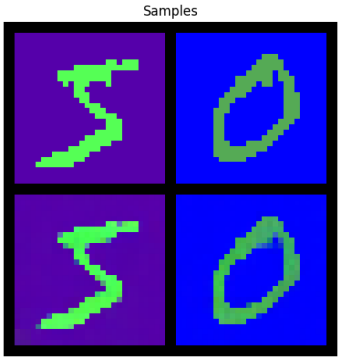
(b) Dataset 2: Samples (caching)

Question 4: Causal Transformer - Tokenized Images

(a) **[5pt] Image Quantization**



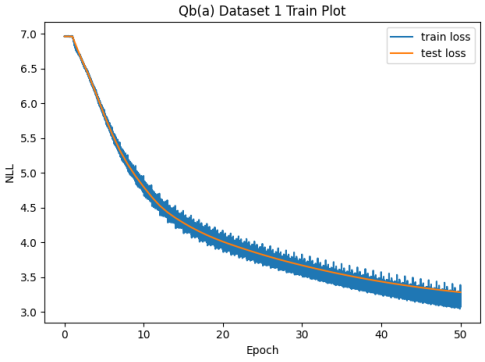
(a) Dataset 1: Quantized Examples



(b) Dataset 2: Quantized Examples

(b) **[15pt] Autoregressive Transformer on Colored Shapes and MNIST with Vector Quantization**

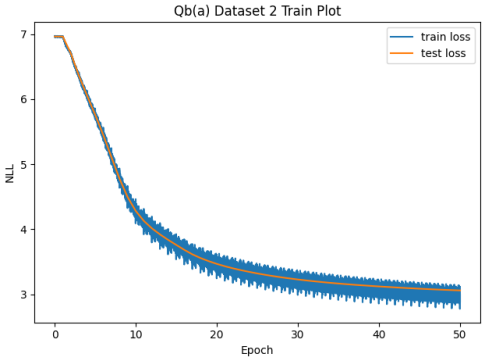
Final test loss for dataset 1: 3.083 nats / dim



(a) Dataset 1: Training curve

(b) Dataset 1: Samples

Final test loss for dataset 2: FILL IN HERE nats / dim



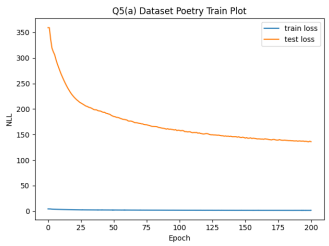
(a) Dataset 2: Training curve

(b) Dataset 2: Samples

Question 5: Causal Transformer - Text

(a) **[20pt] Modeling Text**

Final test loss: FILL IN HERE nats / dim



(a) Training curve

Text Samples

Text Sample 1
Under his death harmbleth more to morely best Forg with eaturnes gone, that into that carent An Lovele the bridal endurns, th

Text Sample 2
Should death, for death. Thy kmid's no mont what when beams it I paine, So as surg, aften what thy heat the fair, or if wayre

Text Sample 3
Thing in sweet their of cheeeks the ather cheeks that do love vewi'd We love of her even worth she most is proced, Which the

Text Sample 4
His captraints and my fimes timre of Flead. Of the lampe barchose sow be one, To stands it her ayde the woddens. A sta

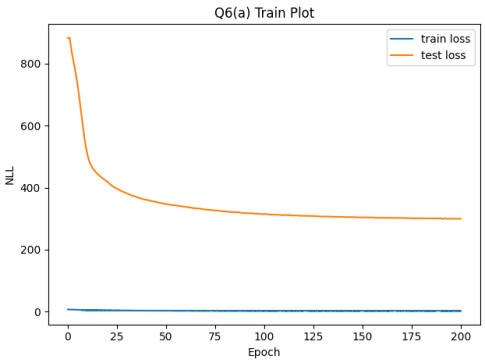
Text Sample 5
Alwho it I selfe so still preasure, But is firmorth over our neshop With work that to knights in love, And is yet comment, g

(b) Text samples

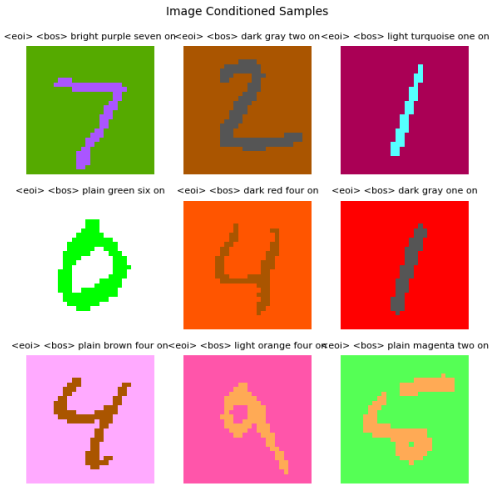
Question 6: Causal Transformer - Multimodal

(a) [20pt] Multimodal Text and Image Generation

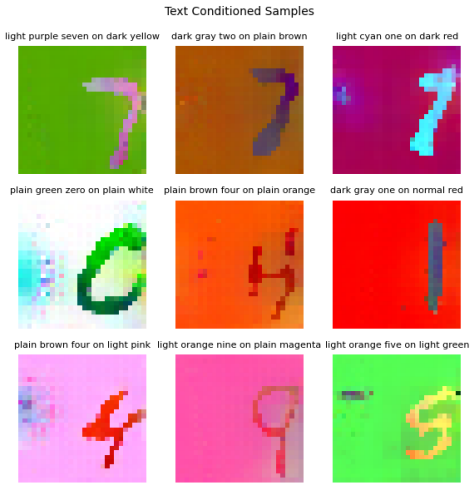
Final test loss: FILL IN HERE nats / dim



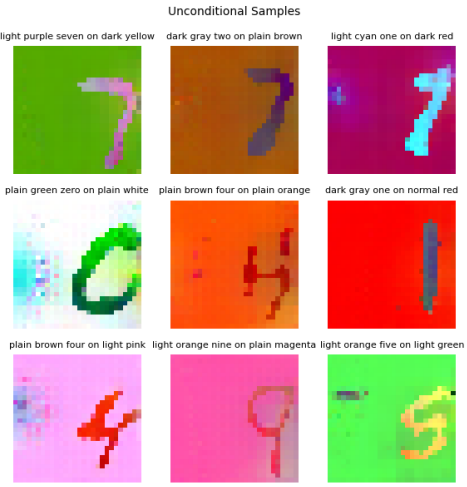
(a) Training curve



(b) Image conditioned samples



(c) Text conditioned samples



(d) Unconditional samples